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Remedial Investigation Report for the

Eastern Michaud Flats Site

Part II
Surface and Subsurface Characterizations

Volume I
Sections 1 – 3

Prepared for
FMC Corporation
J.R. Simplot Company

Copy No. ________

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Bechtel Environmental, Inc.

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Introduction

Part II of the Remedial Investigation (RI) report for the Eastern Michaud Flats (EMF) study area, Surface and Subsurface Characterizations, is a compilation and interpretation of physical and chemical surface and subsurface data collected during various phases of the RI as well as data reported in previous investigations. The EMF study area is defined as the sum of all areas in the vicinity of the EMF facilities investigated during the RI and has no clearly delineated boundaries.

Air monitoring and modeling studies are described in RI Report Part III. An air monitoring summary is, however, presented in Section 4.7 of Part II.

Part II of the RI Report augments "Preliminary Site Characterization Summary for the Eastern Michaud Flats Site" (PSCS) (Bechtel, 1994a). Responses to EPA comments on the PSCS have been incorporated into Part II. Point-by-Point responses to the EPA comments are provided in Appendix T.

Report Objectives

The objectives of Part II of the RI report are to:

- Present and interpret physical data collected during the field surface and subsurface investigations for use in describing the potential pathways for migration of constituents of potential concern.
- Describe the nature and extent of constituents of potential concern in groundwater, surface water, soils, and sediments using the results of laboratory analyses of environmental samples collected during RI field investigations.
- Describe the fate and transport of constituents of potential concern in the environmental media listed above.
- Furnish data for use in the baseline risk assessment to be performed by EPA and its contractor.
- Furnish data for use in identifying potential remedial action objectives.

- Provide a technical foundation and source of information for feasibility studies of potential remedial action alternatives.

Information on the original scope and objectives of the RI is available in previously published documents: RI/FS Work Plan (Bechtel, 1992b), the Phase II Work Plan (Bechtel, 1993c), "Response to EPA Comments on Phase II Site Investigation Plan," by FMC and Simplot (dated August 9, 1993), and the "Ecological Assessment Work Plan" (E&E, 1994).

The RI was performed in accordance with the Administrative Order of Consent (AOC) for Remedial Investigation/Feasibility Study (RI/FS) for the EMF site, issued by the U.S. Environmental Protection Agency (EPA) on May 30, 1991, and entered into by FMC Corporation (FMC) and J.R. Simplot Company (Simplot). These two EMF facilities and surrounding FMC and Simplot properties, hereinafter referred to as EMF properties, encompass approximately 2,450 acres in Power and Bannock counties (Figure 1-1). An aerial photograph of the facilities and surrounding area with the American Falls Reservoir in the background is shown in Figure 1-2. Properties owned by FMC Corporation and the J. R. Simplot Company and their dates of acquisition are shown in Figure 1-3. These properties were owned by each company at the beginning of the remedial investigation in 1992, with two exceptions: the Batiste Spring property and the Swanson property. The Batiste Spring property is a 23-acre parcel purchased from the Union Pacific Railroad by FMC on January 9, 1996, while the Swanson property was purchased by the J.R. Simplot Company on May 31, 1996. FMC is also a treatment, storage, and disposal facility (EPA Identification Number IDD 070929518) under the Resource Conservation and Recovery Act (RCRA).

Report Contents and Organization

The organization of Part II of the RI report is based on the suggested RI report format provided in the EPA document "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA, 1988d).

Section 1 includes descriptions of the FMC and Simplot facility operations. In addition, it summarizes previous environmental investigations with potential relevance to the EMF facilities.

Section 2 provides summaries of field activities, data collection procedures, and analytical methods used during the various investigations and phases of the RI. The information is presented relative to the following topics:

- Potential source and facility soils

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- Surface soils
- Geology and subsurface soils
- Groundwater
- Surface water and sediments
- Land use/demography
- Ecology

Section 3 describes the physical characteristics of the EMF study area based on the results of the investigations conducted for the RI, and includes information on the following:

- Regional hydrology and geology
- Drainage and surface water hydrology
- Site geology
- Site hydrogeology
- Climate
- Demography and land use
- Ecology

Section 4 describes the nature and extent of chemical constituents which appear to be associated with the EMF facilities, hereinafter referred to as "EMF-related" chemicals. The discussion is based on the results of the various phases of investigation conducted for the RI, relative to the following topics:

- Potential sources/facility soils
- Surface soils (beyond facility boundaries)
- Groundwater
- Surface water and sediments
- Aquatic ecology
- Terrestrial ecology

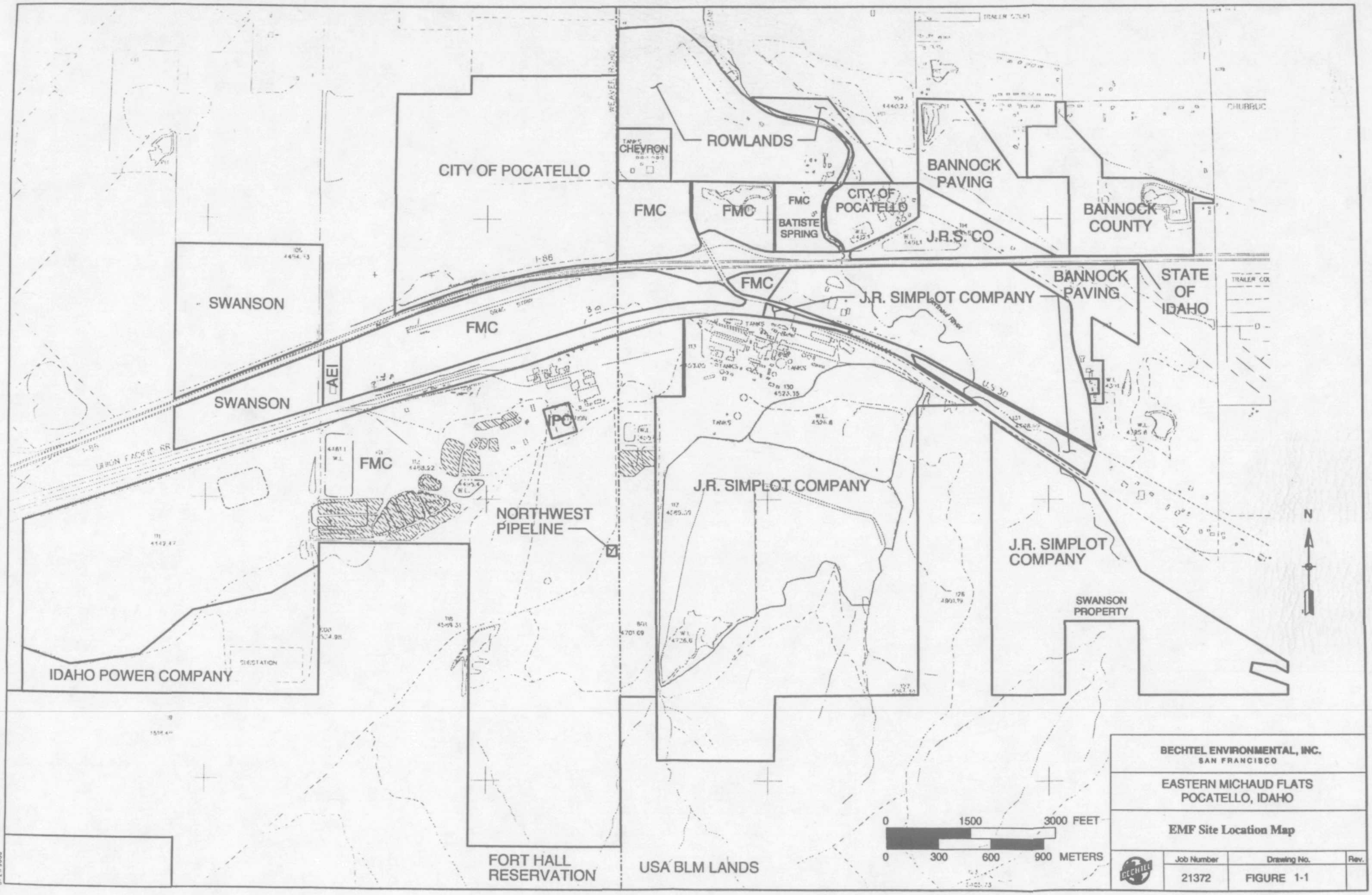
- Air monitoring

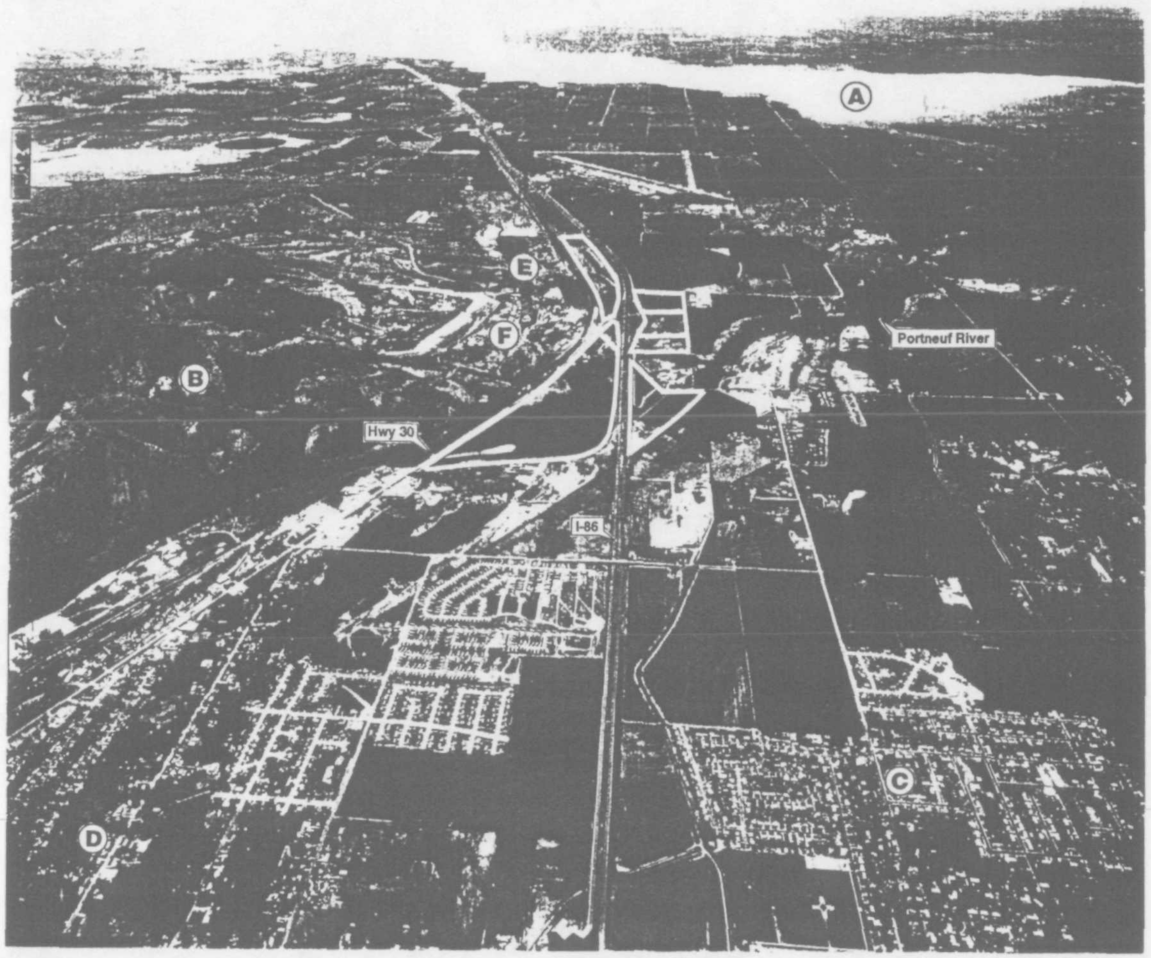
Section 5 describes the fate and transport of chemical constituents within the various environmental media described in Section 4.

Section Contents and Organization

The remainder of Section 1 summarizes FMC and Simplot facility operations and previous environmental studies of, or in the vicinity of, the facilities. Specifically, Section 1.1 discusses the FMC facility manufacturing, by-product handling, and waste management operations, and Section 1.2 discusses the same for the Simplot facility. Previous investigations are summarized in Section 1.3.

Surface and Subsurface Characterizations
Figures for Section 1


CITY OF POCATELLO
CHEVRON
ROWLANDS
BANNOCK PAVING
FMC
FMC
FMC BATISTE SPRING
CITY OF POCATELLO
J.R.S. CO
BANNOCK COUNTY
SWANSON
FMC
J.R. SIMPLOT COMPANY
BANNOCK PAVING
STATE OF IDAHO
FMC
AEI
SWANSON
IPC
FMC
J.R. SIMPLOT COMPANY
NORTHWEST PIPELINE
J.R. SIMPLOT COMPANY
SWANSON PROPERTY
IDAHO POWER COMPANY
N
0 1500 3000 FEET
0 300 600 900 METERS
FORT HALL RESERVATION
USA BLM LANDS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
EMF Site Location Map
Job Number
Drawing No.
Rev.
21372
FIGURE 1-1



A American Falls Reservoir

B Bannock Range

C City of Chubbuck

D City of Pocatello

E FMC Facility

F Simplot Facility

Other Company-Owned Properties
(property boundaries indicated with white line)

Photograph from Walker and Associates,
Seattle, Washington

All property boundaries indicated are approximate.

FIGURE 1-2
EASTERN MICHAUD FLATS STUDY AREA LOOKING WEST

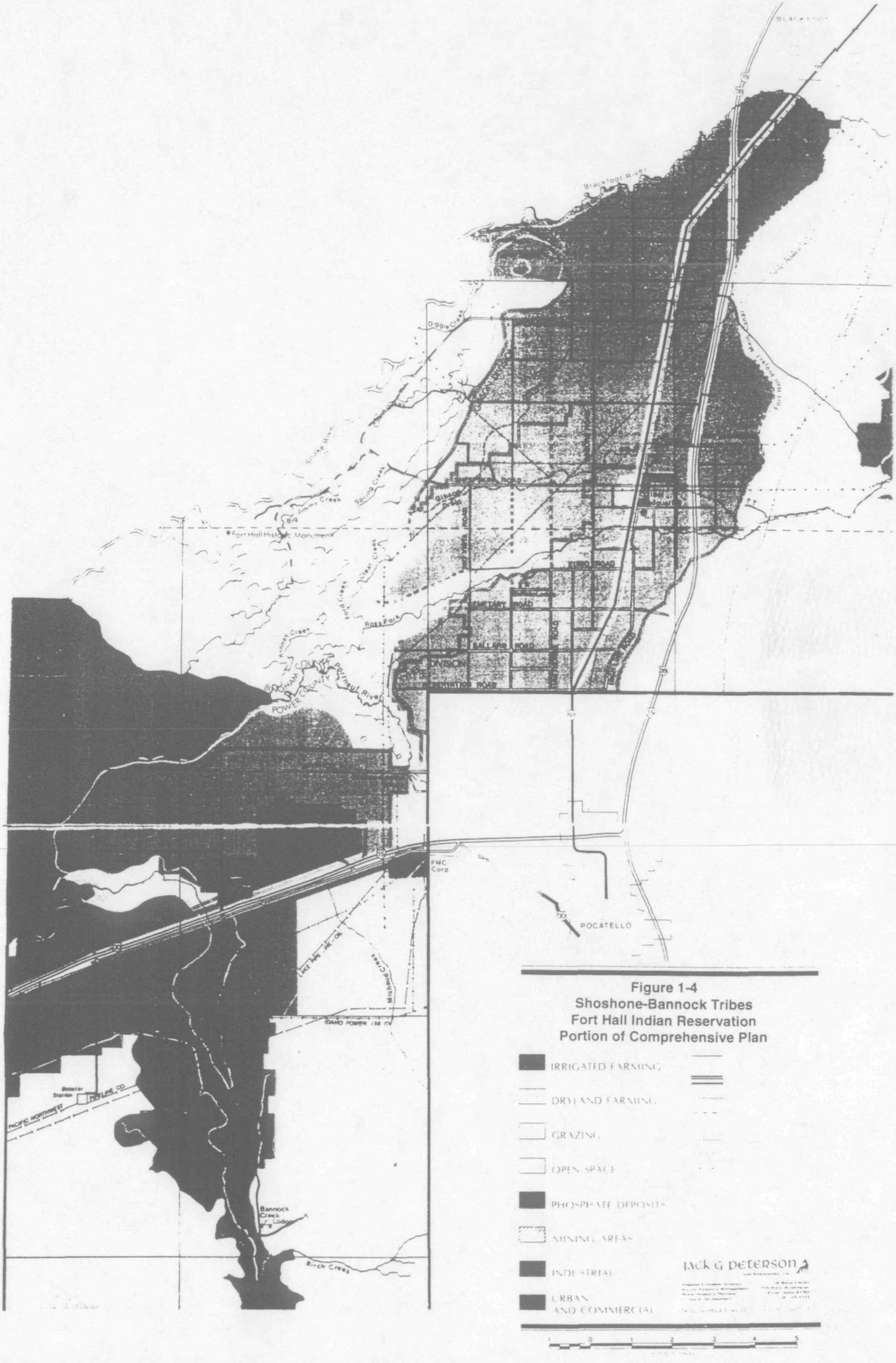


Figure 1-4
Shoshone-Bannock Tribes
Fort Hall Indian Reservation
Portion of Comprehensive Plan

1.1 FMC SITE HISTORY

The FMC Elemental Phosphorus Plant is located approximately 3 miles (4.8 km) northwest of Pocatello, Idaho, and 1 mile (1.6 km) southwest of the Portneuf River, a tributary of the Snake River. The facility covers an estimated 1,189 acres and adjoins the western boundary of the Simplot Don Plant. The facility plan of the FMC plant is shown in Figure 1.1-1. Access to FMC is provided by Interstate Highway 86 (I-86) and U.S. Highway 30.

1.1.1 SUMMARY OF FMC OPERATIONS

Three types of operations are conducted at the FMC facility: manufacture of elemental phosphorus from ore; management of by-products generated during phosphorus production; and management of wastes generated as a result of the above operations. The following is a brief overview of these operations.

The FMC plant produces elemental phosphorus from phosphate-bearing shale ore mined regionally. At present, the ore is shipped to FMC via the Union Pacific Railroad (UPRR) during the summer months. Since ore cannot be shipped during the winter months, it is stockpiled on the facility property to ensure a steady supply for processing throughout the year. The estimated quantity of ore processed at the plant is about 1.5 million tons per year.

Elemental phosphorus production operations at the facility have changed little since plant operations began in 1949. Ore from the stockpiles is sized, briquetted, calcined, and proportioned for feeding into any one of the four electric arc furnaces. The furnace reaction yields gaseous elemental phosphorus in addition to other by-products. The elemental phosphorus is subsequently condensed to a liquid state and stored in tanks prior to shipment offsite as product. Elemental phosphorus will burn upon contact with air. Therefore, to prevent oxidation, the condensed product is covered with water from the time it is generated through its transport off the site.

The primary products are calcium silicate slag and carbon monoxide. Ferrophos is a minor coproduct. By-product and coproduct management generally involves cooling the by-products and either storing them in stockpiles at the site (slag and ferrophos) or reuse in elemental phosphorus production operations (carbon monoxide).

The primary waste stream generated at FMC is wastewater, which contains various suspended and dissolved solids as well as minor amounts of elemental phosphorus. Additional wastes generated are associated with scrubbers and filters located in the furnace and calcining areas and include scrubber blowdowns and used filter media. Liquid wastes are managed in a series of surface impoundments. Examples of other types of solid waste management units include landfills, treatment units, and waste storage areas. Because of the age of the facility, most of the waste management units identified are inactive and no longer receive wastes.

Sections 1.1.2 through 1.1.3 discuss the FMC plant product manufacturing, by-product handling, and waste management operations.

1.1.2 ELEMENTAL PHOSPHORUS PRODUCTION

Elemental phosphorus manufacturing operations conducted at the FMC facility are discussed below. A general process flow diagram is included as Figure 1.1-2.

Stockpiled ore received via railcars is prepared for use as furnace feed material, by first blending, reclaiming, screening, crushing, and sorting, thus providing a consistent size for forming briquettes. The sized ore is formed into charcoal-sized briquettes using continuous roll presses. The briquettes are subsequently heat-hardened at two continuous-grate calciners to drive off any remaining moisture and organic constituents that may be present.

The calcining process generates an off-gas stream containing particulates and naturally occurring radionuclides; these constituents are removed by a series of primary and secondary wet scrubbers located in the calcining area. Calcined briquettes are cooled and transferred to the proportioning building, where they are blended with predetermined ratios of silica and coke.

The furnace operation is considered the central processing step for the production of elemental phosphorus. Furnace burden is gravity fed to the designated furnace; each furnace is equipped with three graphite electrodes, and operates at temperatures ranging from 1450 to 1600°C with a typical off-gas temperature of 500°C. The ensuing reaction yields gaseous elemental phosphorus as well as other by-products.

These gases are cleaned of entrained dust in a two-stage electrostatic precipitator process, and then condensed in primary and secondary water spray condensers to recover the elemental phosphorus. The molten phosphorus is collected in sumps and either offloaded at the product loading area (phos dock) onto rail cars for shipment, or loaded into tanks for interim storage.

1.1.3 WASTE AND BY-PRODUCT MANAGEMENT PRACTICES

Phosphorus production operations at FMC require the use of large quantities of water. To prevent oxidation, elemental phosphorus is stored under water, as are wastes containing elemental phosphorus. The characteristics of elemental phosphorus also require that extensive supplies of fire water be maintained at the facility site. Additionally, water is required for other purposes, including use as makeup water to wet scrubbers, washdown in the furnace building, cold water spray on condensers, and slurrying of precipitator dust from electrostatic precipitators.

Water consumed at the plant is obtained onsite from either the production wells (fresh water) or various surface impoundments or ponds (recycled water). Surface impoundments are crucial for maintenance of the overall water management system at the plant for the following reasons:

- Solids must be covered with water to prevent oxidation and to allow for settling.
- The use of recycled water for process operations requires a high quality of water (i.e., low solids content).
- The amount of wastewater produced exceeds the amount of recycled water required for process operations. In addition to providing for settling of solids, surface impoundments provide the requisite evaporative surface area.

Wastewater has been a significant waste stream generated by FMC during its operational history. Most of the wastewaster has been managed in surface impoundments.

Other wastes at the plant include slag, pond solids dredged from the surface impoundments, waste filter elements, laboratory wastes, and small quantities of wastes generated as a result of ancillary facility operations. In general, the wastes have been stored at various waste storage areas, shipped offsite, or disposed of at the onsite landfills.

Coproduct ferrophos is crushed and sold for its enriched metal value. Carbon monoxide gas is used for its fuel value in the calciners or is flared.

The characteristics, source, and disposition of the FMC waste streams and by-products are summarized in Section 1.1.3.1 below. Associated waste or by-product management facilities are described in Section 1.1.3.2.

1.1.3.1 Waste or By-Product Description

Waste streams at the FMC facility consist primarily of wastewater. These waste streams and other facility wastes or by-products are described below.

Wastewater

Wastewater generated at the facility can be categorized as phossy water, precipitator slurry, scrubber blowdown, or noncontact cooling water.

Phossy Water. Phossy water is defined as any water that has come into contact with elemental phosphorus throughout the process. In the past, all phossy water has been considered hazardous (under RCRA) and has been managed through a series of ponds at the facility. These ponds are the slag pit sump, Pond 8S, the lined Ponds 15S and 16S, and the lined Phase IV ponds (Ponds 11S, 12S, 13S, and 14S).

Phossy water was recharacterized in 1993 based on TCLP analytical results, cadmium being the critical analyte. September 1993 was a RCRA regulatory deadline requiring that FMC's Phase IV ponds stop receipt of hazardous waste. FMC personnel did extensive sampling and TCLP analyses of waste streams going to onsite surface impoundments as part of an effort to insure that the Phase IV ponds would no longer receive phossy water exceeding TCLP limits.

The 1993 TCLP analytical results showed FMC personnel that cadmium sources resulting in exceedences of TCLP limits were identifiable episodic operations. This finding allowed FMC to segregate sources that had the potential to generate phossy water exceeding TCLP limits from those sources that generated phossy water well below the TCLP limits.

Nonhazardous phossy water is directed to the Phase IV ponds while phossy water containing elevated cadmium levels from certain operations is directed to Pond 16S (a pond built to meet RCRA Minimum Technology Standards). These data were submitted to the EPA Region 10 RCRA Program as part of their review of FMC's pond status in late 1993.

As of September 1, 1993, FMC recharacterized sources of phossy water based on extensive sampling, allowing FMC to segregate the phossy water stream into nonhazardous phossy water, which is directed to the Phase IV ponds and hazardous phossy water, which is directed to Pond 16S, a pond meeting RCRA requirements for hazardous wastes.

Precipitator Slurry. This waste stream consists of slurried precipitator dust from the furnace electrostatic precipitator operations. From January 23, 1990, to January 22, 1994, the waste was pumped to the lined Pond 8E, an interim storage pond designed to hold 1 year's supply of slurried dust. Precipitator slurry was dredged from Pond 8E to the lined Pond 9E for solids settlement. Decant from Pond 9E was formerly received by lined Pond 15S and currently by lined Pond 16S, as part of the facility's integrated water management system.

Scrubber Blowdown. The blowdown from the calciner and the Medusa scrubbers is discharged to the onsite wastewater treatment unit for pH adjustment. The treated blowdown is clarified in the lined calciner ponds (Ponds 1C, 2C, 3C, and 4C) before being recycled back to the plant as makeup water for the calciner scrubbers.

Noncontact Cooling Water. Noncontact cooling water consists primarily of fresh water, and is used for activities such as secondary cooling loops, furnace cooling, and calciner water beams. This water is typically sent to the industrial wastewater (IWW) basin for cooling; from there it is discharged to Portneuf River via the IWW ditch (NPDES Permit ID-000022-1). Water from the IWW basin can also be sent back to the plant for use as recycled water.

By-products and Coproducts

By-products at FMC are generated during reactions within the electric arc furnaces and consist of carbon monoxide gas and calcium silicate slag, also referred to as slag. The coproduct ferrophos is also generated in the furnaces.

Carbon Monoxide. Carbon monoxide gas is passed through the secondary condenser for further phosphorus recovery. The gas is then either used as primary fuel for the calcining process or flared.

Slag and Ferrophos. The molten material that remains in the furnaces during elemental phosphorus production consists of slag and ferrophos. Each of these materials is tapped from the furnaces several times per day. The tapping process is performed in a hood-type arrangement to allow for collection of any fumes generated during the tapping process. These fumes first pass through a Medusa wet venturi action scrubber, and then through Andersen filter dry scrubbers.

The molten slag flows out of the tap holes and into a slag pit, where it is sprayed with water for cooling and fracturing. The cooled, vitrified slag is loaded into haul trucks for placement in the slag piles. Historically, this material has been used extensively for paving and as fill material on the facility property and in the City of Pocatello.

Analyses of slag characteristics have resulted in the following conclusions:

- The material contains detectable levels of aluminum, arsenic, boron, cadmium, calcium, chromium, fluoride, total phosphorus, sodium, potassium, vanadium, and zinc.
- Slag passes the Toxicity Characteristic Leaching Procedure (TCLP) test prescribed by RCRA, as codified in 40 CFR 261 (i.e., concentrations of specific constituents in slag, such as cadmium and arsenic, do not exceed hazardous waste threshold concentrations for corresponding constituents specified by RCRA).
- Migration of constituents from this material into the subsurface is not considered to be of concern.

The coproduct ferrophos is a phosphorus and iron alloy, which also contains detectable levels of chromium, nickel, silver, and vanadium. It is collected in sand molds and cooled in the furnace building. The ferrophos is transferred to ferrophos piles located on the site, and subsequently sold.

Andersen Filter Media (AFM) Wastes

AFM is used in scrubbers in the furnace tapping and phos dock fume treatment operations. In 1990, when the plant became subject to RCRA, the AFM was found to contain arsenic and cadmium. Since 1990, the AFM has been sent to an offsite RCRA-permitted landfill. In 1991, FMC began treatment of the media through a washing unit. The rinse waters generated are subsequently treated along with the calciner and Medusa scrubber blowdowns at the wastewater treatment unit. Used AFM is stored at the facility until a full shipment can be sent offsite for disposal. Prior to 1990, AFM was disposed of at the onsite landfill.

Miscellaneous Wastes

Other wastes generated at FMC include small quantities of waste paint, spent solvents (from degreasing and laboratory operations), office trash, asbestos waste, and used transformer oil. Office trash, asbestos waste, and used Andersen filter media (prior to regulation) have been disposed of at the onsite landfill. Transformer oil has been shipped to various handlers through the years, and is currently being shipped to Aptus. Spent laboratory and degreasing solvents have been shipped offsite to FMC-approved disposers.

A categorization of the potential source materials handled at the FMC plant is indicated below:

FMC POTENTIAL SOURCE MATERIALS	CLASSIFICATION
• shale ore	• feedstock
• slag	• by-product
• ferrophos	• product
• phossy liquids	• waste
• precipitator slurry	• waste
• coke	• feedstock
• calciner fines	• by-product
• silica	• feedstock
• office trash	• waste
• phosphorus	• product

Air Emissions

Air emissions from the FMC facility are regulated by the state of Idaho (Air Permit 1260-00050). The FMC facility permit covers the shale handling/ crushing operations, the calciners, various material handling systems, the four electric arc furnaces, the electrostatic precipitators, the carbon monoxide flaring system, and the phos dock. Parameters regulated include phosphorus, sulfur (contained in fuel), and particulate emissions.

1.1.3.2 Waste or By-Product Management Facilities

This section briefly describes the waste management facilities and potential source areas at the FMC facility. The locations of these waste management facilities are shown in Figure 1.1-1. Some of these facilities are RCRA waste management units. Descriptions of waste management

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units are provided in the RCRA Part B permit application submitted to the EPA on March 1, 1991.

Surface Impoundments

Currently, the various wastewater streams are managed in the following 11 lined ponds:

- Phase IV ponds (Ponds 11S, 12S, 13S, and 14S) — nonhazardous phossy water
- Precipitator ponds (Ponds 8E and 9E) — precipitator slurry. These ponds will manage non-hazardous precipitator slurry in 1995.
- Pond 16S — hazardous phossy water, precipitator slurry
- Calciner ponds (Ponds 1C, 2C, 3C, and 4C) — treated stream from wastewater treatment.

In 1993, FMC submitted closure plans for three surface impoundments: Ponds 15S and 8S, and the slag pit sump. All of these units are currently inactive. Ponds 8S and 15S are receiving only nonhazardous water for level control. Also in 1993, FMC's RCRA Part B permit application was revised to reflect the change in service to nonhazardous operations and delay of closure for the Phase IV ponds.

In addition, at least 24 former ponds have been identified as having been used to manage wastewater on the FMC facility property; they are as follows:

- Old settlement ponds (Ponds 00S, 0S, 1S, 2S, 3S, 4S, 5S, 6S, 7S, 9S, and 10S)
- Old evaporation ponds (Ponds 1E, 2E, 3E, 4E, 5E, 6E, and 7E)
- Kiln scrubber and overflow ponds (consisting of three kiln scrubber ponds which overflowed to one overflow pond)
- Former calciner ponds (old Ponds 1C and 2C)

These ponds were removed from service. Several of the active surface impoundments were later constructed over these former ponds as shown in Figure 1.1-1. Determination of the extent of these former ponds is based on examination of aerial photographs since design and construction records for these ponds are not available, and only approximate dimensions and capacities, and limited information on associated structures (if any) are known.

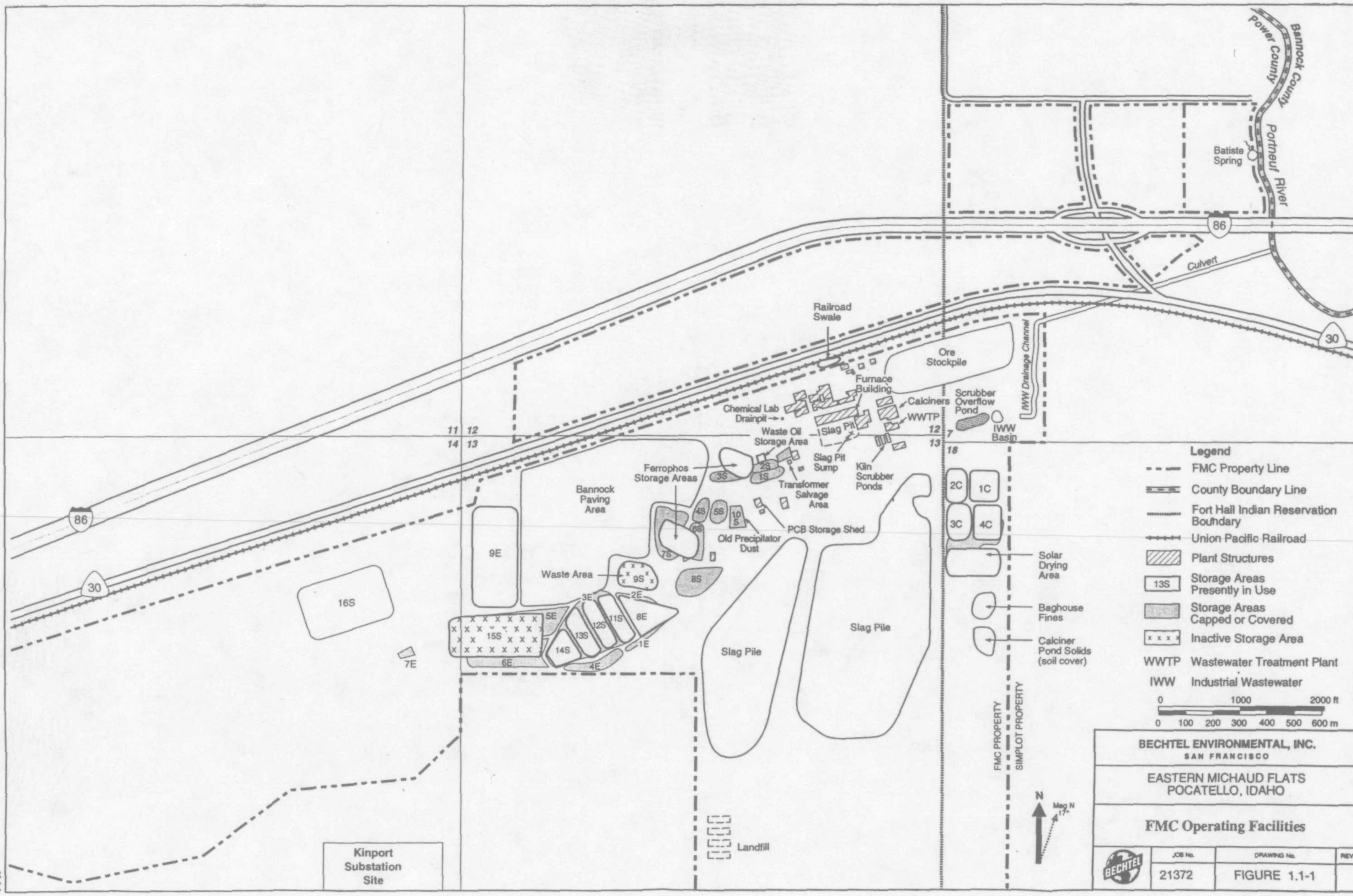
IWW Basin and Ditch

The IWW basin, used to cool noncontact cooling water, is 131 feet (40 m) by 102 feet (31 m), and 4 feet 6 inches deep (1.4 m). Wastewater from this unit is either sent back to the plant for reuse, or discharged to the Portneuf River via the IWW ditch that exits the facility at the northeast corner of the property (Figure 1.1-1). The ditch is approximately 1,700 feet (518 m) long, and averages about 6 feet (1.8 m) in width and 3 feet (0.9 m) in depth. Both the basin and the ditch are unlined.

Landfills

The FMC facility contains two landfills, only one of which is currently active. The inactive (old) landfill was removed from service and covered with slag in 1980, upon construction of the new landfill. Reportedly, the old landfill received used AFM, facility trash and debris, asbestos wastes, and fluid bed drier wastes. The new landfill has received used AFM, office trash, and asbestos wastes.

Surface and Subsurface Characterizations
Figures for Section 1.1



Legend
FMC Property Line
County Boundary Line
Fort Hall Indian Reservation Boundary
Union Pacific Railroad
Plant Structures
13S
Storage Areas Presently in Use
Storage Areas Capped or Covered
Inactive Storage Area
WWTP Wastewater Treatment Plant
IWW Industrial Wastewater
0 1000 2000 ft
0 100 200 300 400 500 600 m
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
FMC Operating Facilities
JOB No. 21372
DRAWING No. FIGURE 1.1-1
REV.
BECHTEL
N
Mag N 17°
Bannock County
Power County
Portneuf River
Batiste Spring
86
30
Culvert
Railroad Swale
Ore Stockpile
IWW Drainage Channel
Furnace Building
Scrubber Overflow Pond
Calciners
WWTP
IWW Basin
Chemical Lab Drainpit
Slag Pit
Waste Oil Storage Area
Slag Pit Sump
Kiln Scrubber Ponds
Ferrophos Storage Areas
Transformer Salvage Area
PCB Storage Shed
Old Precipitator Dust
Bannock Paving Area
Waste Area
Slag Pile
Slag Pile
Solar Drying Area
Baghouse Fines
Calciner Pond Solids (soil cover)
FMC PROPERTY
SIMPLOT PROPERTY
Landfill
Kinport Substation Site
1C
2C
3C
4C
1S
2S
3S
4S
5S
6S
7S
8S
9S
10S
11S
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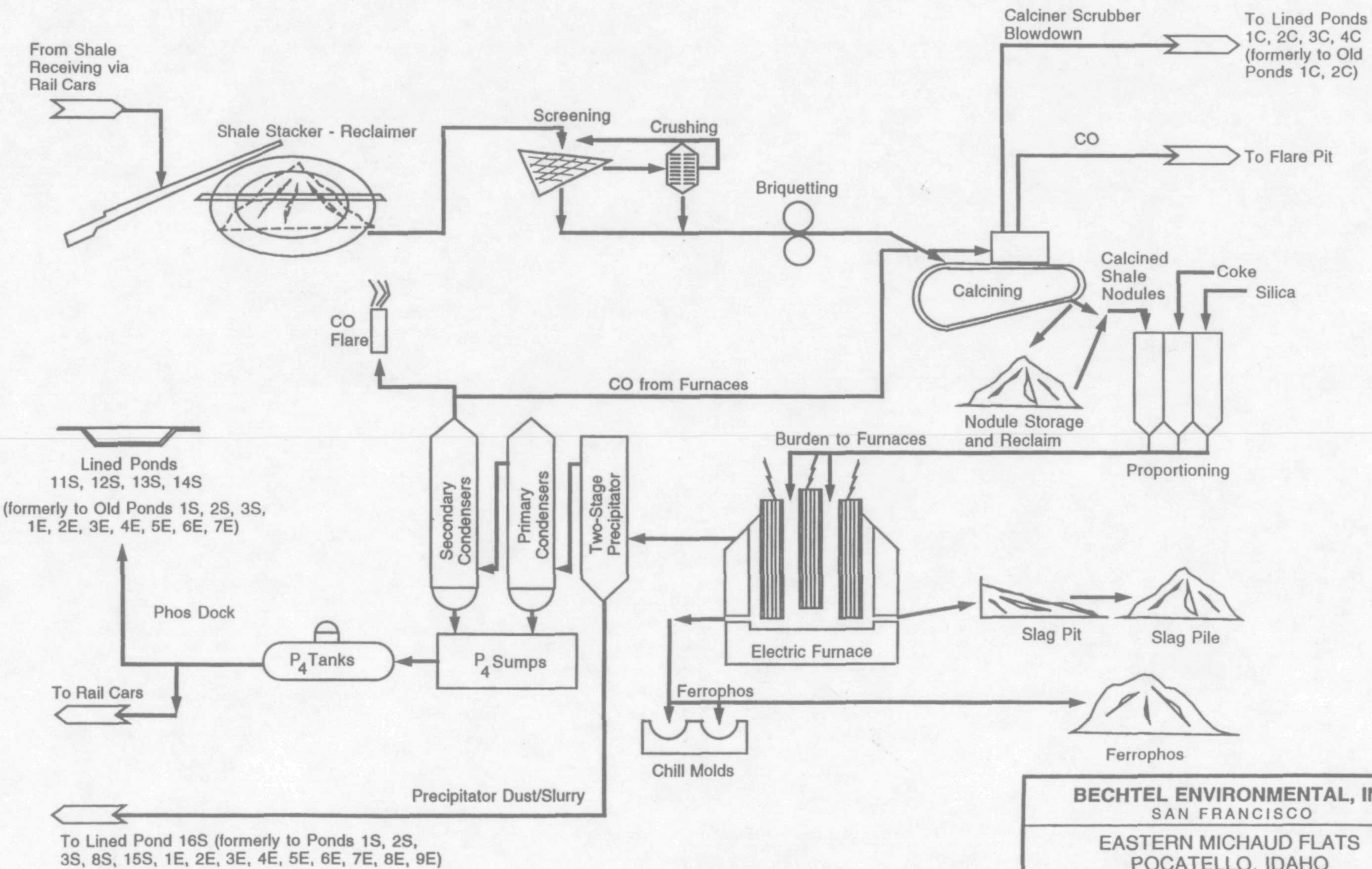

Note: "Old Ponds" are those that are no longer operational.

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SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

FMC General Flow Diagram

JOB No.	DRAWING No.	REV.
21372	FIGURE 1.1-2	

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1.2 SIMPLOT SITE HISTORY

The Simplot Don Plant, approximately 2.5 miles (4 km) west of Pocatello, Idaho, began production of single superphosphate fertilizer in 1944. Phosphoric acid production began in 1954. The facility covers approximately 745 acres and adjoins the eastern property boundary of the FMC facility. The Simplot facility lies approximately 500 feet (150 m) southwest of the Portneuf River. A facility plan of the Simplot plant is provided in Figure 1.2-1. Access to Simplot is provided by I-86 and U.S. Highway 30.

1.2.1 SUMMARY OF SIMPLOT OPERATIONS

The Simplot plant produces phosphoric acid from phosphate ore using a wet (aqueous) process. Phosphate ore was formerly transported from the Gay, Conda, and Smoky Canyon mines to the plant via railcar. As of September 1991, the Simplot plant began receiving phosphate ore through a slurry pipeline solely from the Smoky Canyon mine.

In preparation for transport, the phosphate ore is crushed and beneficiated (physically washed) at the Smoky Canyon phosphate mining/processing plant. Fine and coarse materials generated from the crushing process are separated in sequence by classifiers and a hydroclone system. The beneficiation process yields a 31-percent equivalent phosphorus pentoxide (P_2O_5) concentrate suitable for production of phosphoric acid. The slurry is transported to the Simplot facility through the buried pipeline.

Upon arrival at the plant, the slurried phosphate ore is thickened to approximately 70 percent solids content before being stored in agitated tanks. It is pumped directly into the phosphoric acid reactor from the storage tanks. The phosphoric acid is further processed into a variety of solid and liquid fertilizers. The plant produces 12 principal products, including five grades of solid fertilizers and four grades of liquid fertilizers.

The plant is an integration of several different processing units, each unit producing either an intermediate or a final product. A block flow diagram summarizing Simplot's operational processes is provided in Figure 1.2-2. Summaries of each plant and its respective products are presented below.

1.2.1.1 Phosphoric Acid Plant

The ground ore is digested for several hours with sulfuric acid to produce phosphoric acid (26- to 30-percent equivalent P_2O_5) and a hydrated calcium sulfate by-product (gypsum). Phosphoric acid process descriptions refer to equivalent P_2O_5 levels at each stage of production because the acid is sold according to its equivalent P_2O_5 content. The phosphoric acid/gypsum slurry is pumped to a vacuum filtration system for separation of the gypsum solids from the phosphoric acid liquid. The phosphoric acid is then used to make the various grades of fertilizers either as is or after concentration to 44- to 52-percent equivalent P_2O_5 by vacuum evaporation. The gypsum slurry is thickened to 25- to 40-percent solids to minimize water consumption, and is then pumped to the gypsum stack.

1.2.1.2 Sulfuric Acid Plant

Simplot produces sulfuric acid (H_2SO_4) used primarily for the production of phosphoric acid. Liquid sulfur is burned with air to form sulfur dioxide (SO_2), which is then reacted with oxygen over a catalyst to form sulfur trioxide (SO_3). The SO_3 is absorbed in water, in the presence of 98-percent sulfuric acid, to form H_2SO_4.

1.2.1.3 Ammonium Phosphate Plants

Several grades of solid fertilizers are produced in the ammonium phosphate (ammo-phos) plants. Phosphoric acid, sulfuric acid, and ammonia are mixed in a reactor to form a slurry. The slurry is combined with recycled ammo-phos product in a granulator. The slurry coats the recycled particles, forming a larger particle of ammo-phos. The granulated product is then dried and screened, with the intermediate-sized particles being the final product. The oversized material is crushed and recycled with the fines.

1.2.1.4 Ammonium Sulfate Plant

Ammonium sulfate is a solid fertilizer produced by the reaction of ammonia and sulfuric acid under vacuum. The vacuum crystallization reaction forms product crystals which are separated from liquid by centrifuging. The crystals are dried and stored as product, and the liquid is recycled. A major source of ammonium sulfate to the plant is an ammonium solution from the Amm SO_x scrubber on the #3 sulfuric acid plant.

1.2.1.5 Triple Superphosphate Plant

Triple superphosphate is a solid fertilizer currently produced by a patented process. The resulting acidulated solid is granulated, dried, and screened. Dicalcium phosphate is also manufactured at the plant for use as an animal feed supplement.

1.2.1.6 Super Acid Plant

Super phosphoric acid (68-percent equivalent P_2O_5) is produced by concentrating phosphoric acid through vacuum evaporation. The water vapor that is removed in the super acid plant is condensed and returned to the phosphoric acid plant for reuse.

1.2.1.7 Liquid Fertilizer Plant

Liquid ammo-phos is produced by reacting ammonia, water, and super phosphoric acid.

1.2.1.8 UAN-32 Plant

UAN-32 is a liquid solution of urea and ammonium nitrate used as a fertilizer. It is produced by combining ammonium nitrate and urea solution to produce a 32-percent nitrogen solution. Nitric acid is also produced at the facility, by the conversion of ammonia into nitric oxides and subsequent solution in water. The ammonium nitrate is produced by the reaction of nitric acid and ammonia. Urea is produced by a reaction between carbon dioxide and ammonia in an autoclave.

1.2.1.9 Ammonia Plant

The ammonia used in plant processes is produced at the facility using natural gas, steam, and air. Steam and natural gas are passed over a catalyst at high temperature and pressure to form hydrogen and carbon monoxide. Air is mixed with this gas stream, and the carbon monoxide is subsequently converted to carbon dioxide which is absorbed in a recirculating UCARSOL© solution. Unabsorbed carbon dioxide is reacted with hydrogen in a methanator forming methane and water. The major process gas stream now contains hydrogen, nitrogen, and water. The water is removed, and the process gas stream is compressed and reacted over a catalyst to form ammonia. The absorbed carbon dioxide is recovered and used in the production of urea or sold to Airco.

1.2.2 Waste or By-Product Description

The main waste or by-product streams generated at the Simplot facility are the gypsum solids and liquids generated in phosphoric acid production. Other waste streams generated at the site include waste oils and various solvents. The Simplot facility also treats noncontact water in a series of three water treatment ponds. The treated water is nutrient rich and is sold for irrigation and fertilization.

A categorization of the potential source materials handled at the Simplot plant is indicated below:

Simplot Potential Source Materials	Classification
• phosphate ore	• feedstock
• gypsum solids and liquids	• waste
• fertilizer formulations	• products
• waste oils and solvents	• recycled
• sulfur	• feedstock
• irrigation water	• recycled by land application
• UAN-32	• product
• treatment pond sediment	• waste
• office trash	• waste
• former east overflow pond sediments	• waste

1.2.2.1 Gypsum Solids and Liquids

The gypsum produced from the phosphoric acid process is slurried (25- to 40-percent solids) and pumped to the top of the gypsum stack. A series of perforated high-density polyethylene (HDPE) pipes located beneath the gypsum stacks collects some of the water used to slurry the gypsum, and this recovered water is recycled for further use in plant processes.

1.2.2.2 Waste Oils and Solvents

Waste oils are separated from water in a waste oil separator prior to collection in a waste oil storage tank. These waste oils are collected weekly for recycling by Cowboy Oil. Spent solvents are collected by Safety Kleen for recycling.

1.2.2.3 Noncontact Water and Laboratory Wastes

Boiler and cooling tower blowdown, compressor coolant water, demineralizer regeneration water, storm water, and laboratory wastes (i.e., acids, ammonia, and sodium hydroxide) are collected and treated in a series of lined ponds described in Section 1.2.3.3.

1.2.2.4 Irrigation Water

Nutrient-rich noncontact water and stormwater treated in the series of three lined ponds, north of the plant between Highway 30 and the Portneuf River, have been sold for irrigation/fertilization since July 1980 under a joint land-application permit with the City of Pocatello. Prior to July 1980, the treated water was discharged to the Portneuf River (NPDES Permit ID000067).

The EPA funded the Joint Waste Treatment Feasibility Study, Project EPA P0000080-03, which evaluated effluent handling alternatives available to the Pocatello STP and local industries. The study evaluated the suitability of wastewaters for irrigation, including characteristics of nutrient level, salinity, organic loading, sodium absorption ratio, and trace elements. The trace elements evaluated included aluminum, arsenic, boron, cadmium, chromium, cobalt, copper, fluoride, iron, lead, manganese, nickel, selenium, and zinc. The recommendations from the study in Report No. 219 concluded that "the EPA and the State Division of Environment should, where possible, assist and encourage the City of Pocatello and J.R. Simplot Company toward the completion of the land application project. Implemented by: Idaho Department of Health and Welfare and EPA." The recommendation was given force by an EPA AOC in 1978.

Under the AOC, Simplot chose to eliminate discharges to the Portneuf River by land application of the nutrient-rich water under the State of Idaho Land Application permit system. In 1992, a permit was issued to Simplot and the City of Pocatello for operation of part of the system (Land Application No. LA-000104, 8/17/92).

A comparison of analytical data for Simplot's irrigation water with the EPA's land-application limits for wastewater shows that the concentrations of the various inorganic compounds are considerably below the EPA-recommended concentration limits.

1.2.2.5 Air Emissions

Air emissions from the Simplot facility are regulated by the state of Idaho (Air Permit 1260-0060). The permit covers gaseous and/or particulate emissions from ore handling activities, individual process plants, and the reclaim cooling towers. Simplot has made a number of plant modifications to substantially reduce particulate matter emissions. Included in the plant modifications was the elimination of calciner units in 1990 and unenclosed raw ore handling facilities in 1991. Elimination of calciner units reduced total plant carbon monoxide and oxides of nitrogen emissions. Elimination of the unenclosed raw ore handling facilities through the use of a slurry pipeline greatly reduced not only the total particulate matter emissions but fluoride and radionuclide emissions as well.

1.2.3 WASTE OR BY-PRODUCT MANAGEMENT FACILITIES

There are currently two gypsum stacks and several ponds at the Simplot facility. In addition, a solid waste landfill and a trash landfill are also used at the facility. A brief summary of each of these waste management facilities, including the types of wastes contained, is presented below.

1.2.3.1 Gypsum Stacks

There are two gypsum stacks on the facility grounds south of the plant operating areas. The original gypsum stack is the northernmost of the two stacks. The southernmost stack has been in use since 1966. Together, the two gypsum stacks occupy an area of approximately 340 acres. Simplot is in the process of raising the level of the lower, northernmost stack and merging the two stacks into one.

1.2.3.2 Former East Overflow Pond

The former east overflow pond was an unlined surface impoundment approximately 0.8 acres in size. It is located east of the plant operational areas. When operational, this pond received surface water runoff as well as excess process water from the plant water reclaim system in the event of a power failure or other process upset. Reclaimed system water included gypsum filter wash water, scrubber water, and cooling tower water. Water collected in this pond was pumped back to the reclaim water system. The pond also had an emergency discharge system that enabled discharge of water to the water treatment ponds via gravity flow through an underground pipeline. Use of the former east overflow pond was discontinued in August 1993 when a lined replacement pond (Reclaim Water Pond No. 1), adjacent to the original pond, was put into service.

1.2.3.3 Water Treatment Ponds

A series of lined ponds, north of the plant between Highway 30 and the Portneuf River, is used to treat the noncontact water, laboratory wastes, and storm water referenced in Section 1.2.2.3. The noncontact water is collected by a facility drainage system and flows through a pipe under Highway 30 into a plastic-lined holding pond for pH adjustment or into a lined equalization pond.

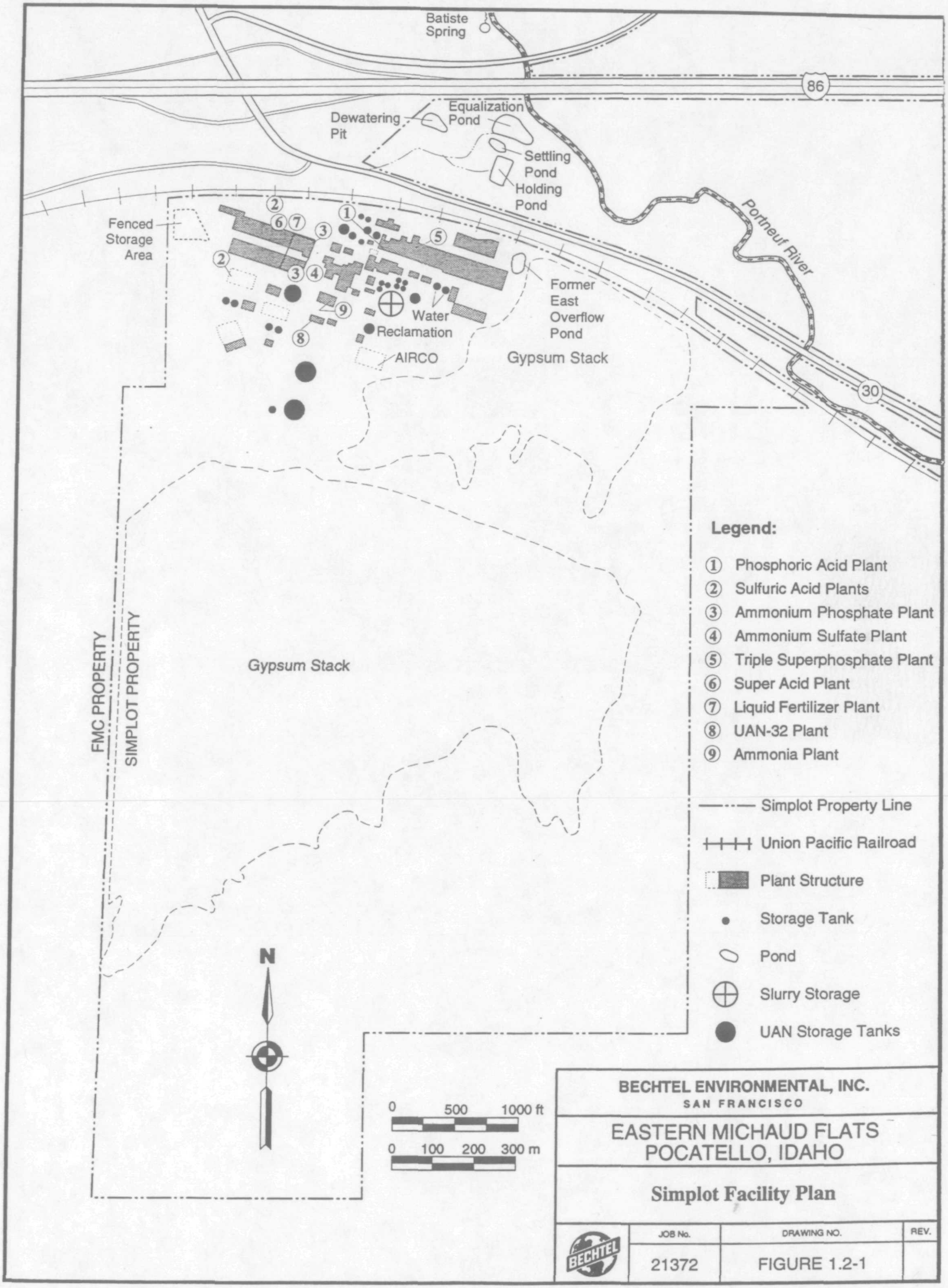
Water in the holding pond is pH-adjusted with soda ash before it flows to a concrete-lined settling pond for clarification. After the suspended solids have settled out of the water, the treated water flows to the equalization pond where it is combined with the water that did not require pH adjustment. The equalization pond liner is constructed of clay, bentonite, and compacted soil to which a chemical sealant has been added. Equalization pond water is pumped to a large lined surge pond located north of Interstate 86 for storage prior to being used for irrigation and fertilization. The surge pond liner construction is the same as that of the equalization pond. The treated water is nutrient-rich and has been sold for irrigation/fertilization since July 1980 under a joint land application permit with the City of Pocatello as described in Section 1.2.2.4. From time to time, sediments have been dredged from the ponds and transferred to an unlined dewatering pit adjacent to the ponds. Sediments were dredged from the equalization pond on only one occasion in late 1991 or early 1992. Prior to that time, sporadic unsuccessful attempts were made to remove sludge/sediments from the solids settling pond. Sediments have not been removed from the unlined dewatering pit.

1.2.3.4 Landfills

A solid waste landfill is located between the gypsum stacks. It lies partly on native soil and partly on the northernmost gypsum stack. The initial date of operation of this landfill is unknown. Construction wastes, demolition rubbish, and neutralized solid wastes from spills were disposed of in the solid waste landfill.

Simplot previously disposed of general office waste and garbage from the lunchroom in two trash landfills. The more recently used landfill is located above the southernmost gypsum stack; the older landfill is northwest of the more recently used landfill. Simplot now sends trash offsite.

Surface and Subsurface Characterizations
Figures for Section 1.2

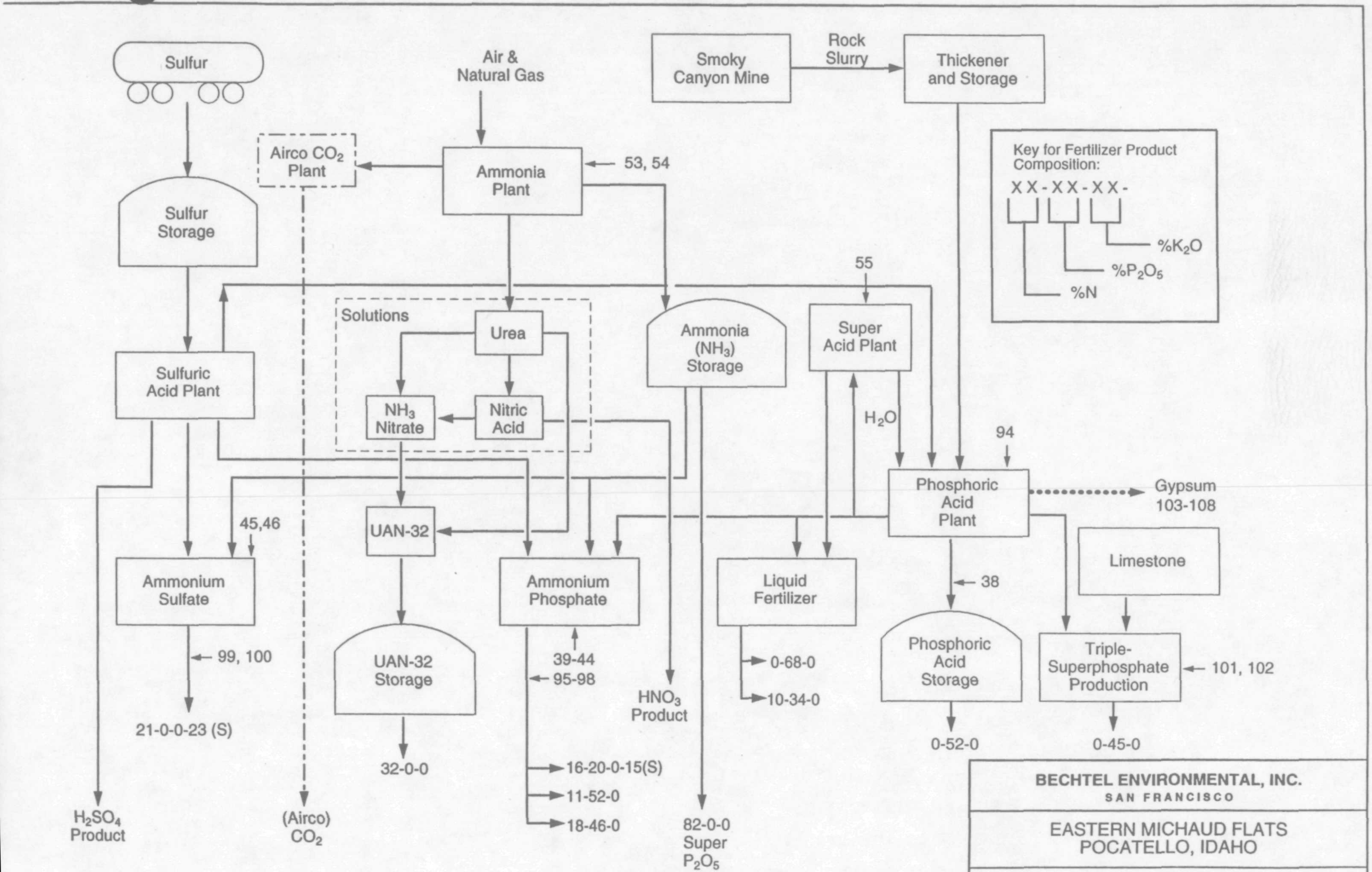


BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Simplot Facility Plan

JOB No.	DRAWING NO.	REV.
21372	FIGURE 1.2-1	



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POCATELLO, IDAHO

Simplot General Flow Diagram

JOB No.	DRAWING No.	REV.
21372	FIGURE 1.2-2	

Note:

95-2395b.005

1.3 SUMMARY OF PREVIOUS INVESTIGATIONS

The EMF study area has been the subject of a number of historical investigations, conducted to address a variety of resource and ecological issues. It should be noted that the findings of the previous investigations are presented in this section as reported by the study authors, and do not necessarily reflect the findings of the RI. The scope of these studies ranged from peer reviewed papers to unpublished undergraduate studies. The investigations focused on specific media, as follows:

- Regional studies of the EMF study area – media investigated include springs, groundwater, surface water, river sediments, aquatic ecology, terrestrial wildlife and habitats, vegetation, and air quality.
- Studies on the FMC facility property – media investigated include soils and groundwater.
- Studies on the Simplot plant property – media investigated include groundwater.

This section summarizes the previous investigations performed in the EMF study area, and at the FMC and Simplot facilities. Only brief overviews of the area-wide investigations are provided in this section. These investigations are discussed in more detail in Appendix A.

This section focuses first on regional investigations conducted in the EMF study area (Sections 1.3.1 through 1.3.6), and then on investigations of the EMF facilities (Sections 1.3.7 and 1.3.8). Of the area-wide studies, those addressing the general water chemistry of springs and groundwater are presented initially, as they provide an overview of the sources and movement of unimpacted surface water and groundwater. They are followed by characterizations of the sources of water and the relationship of spring and groundwater chemistry, which provide preliminary insight into the source and distribution of chemical constituents.

Accordingly, Section 1.3 is organized as follows:

- Section 1.3.1 discusses the general water chemistry of both springs and groundwater in what is now referred to as the EMF study area.

- Sections 1.3.2 through 1.3.4 identify the constituents present in specific media in the EMF study area.
- Section 1.3.5 discusses previous investigations of the aquatic ecology of the Portneuf River and of terrestrial wildlife and habitats within the EMF study area.
- Section 1.3.6 summarizes previous investigations of air quality in the EMF study area.
- Sections 1.3.7 and 1.3.8 summarize past investigations conducted at the FMC and Simplot facilities, respectively.

The regional setting of the EMF study area is shown in Figure 1.3-1.

1.3.1 CHARACTERIZATION OF GENERAL WATER CHEMISTRY

Previous investigations conducted in the EMF study area involved the characterization of the general water chemistry of springs (downgradient of the EMF facilities) and groundwater. Towards this end, basic water chemistry data on the naturally occurring constituents in springs and groundwater were collected and analyzed. This section presents the results of and conclusions drawn by the previous investigations for the springs studied, followed by the same for groundwater. Additional details on each investigation are presented in Appendix A.

1.3.1.1 Springs

Previous investigations conducted at springs along the Portneuf River within the EMF study area are as follows:

- Perry et al. (1990) and Goldstein (1981) attempted to characterize the source(s) of springs studied.
- Jacobson (1982, 1984, and 1989) monitored the water quality of Batiste Springs as part of hydrogeologic investigations conducted over a period of 7 years.

In general, data collected during each investigation showed that most of the spring waters along the Portneuf River belong to a calcium bicarbonate system. Perry et al. (1990) went on to classify 27 of the 28 springs studied into four groupings of springs within the overall calcium bicarbonate system, based on additional characteristic parameters such as conductivity, selected nutrients, and fluoride. These four groups, indicated in Figure 1.3-2, were identified as follows:

- Batiste System (Group I)
- Swanson Road System (Group II)
- East Side System (Group III)
- Papoose System (Group IV)

The Perry study did not include Willow Spring (Figure 1.3-1) in the four groupings because it was markedly different, having a sodium/potassium chloride water chemistry and overall higher ionic concentrations than any other spring studied.

Both Perry et al. (1990) and Goldstein (1981) attempted to characterize the source of water for the springs sampled in each respective study. However, conclusions drawn by both studies could only be tentative, as each study examined only limited data. The Perry study examined a narrow geographical area (less than 2 square miles), and the Goldstein study examined a restricted number of springs (seven).

Both Perry and Goldstein suggested that the springs in the Portneuf River basin issue from the Michaud Gravel and the American Falls Lake Bed Formation, which also underlie the EMF study area. Additionally, Perry noted that, based on water chemistry, Groups II, III, and IV each included springs from both the east and west side of the Portneuf River, suggesting that the river is not a hydraulic barrier to subsurface flow in the area north of I-86. Additional data collected during the RI indicate that the river is, in fact, a hydraulic barrier north of I-86 (Section 3.3).

Perry described the water chemistry of these three groups as representing downgradient (downstream) gradation (i.e., paralleling the discharge of the Portneuf River), suggesting that these springs may represent underflow from the river. Both authors suggested that springs in the Batiste System represent a source of water other than that of the rest of the springs studied.

As part of the USGS hydrogeologic investigations, Jacobson collected water chemistry data for five springs in 1980 (Jacobson, 1982). Additional water chemistry data were collected for two of these springs [Batiste and Twenty-West in 1981 and 1982 (Jacobson, 1984), and Batiste Spring from 1982 through 1987 (Jacobson, 1989)]. The investigations were initiated as a result of degraded water quality found in the Pilot House Well in 1972. The data were collected to monitor changes in groundwater and spring quality in the Michaud Flats area. Incidental to the main focus of the investigation, the study concluded that Batiste Spring had been impacted, and noted the proximity of the spring to the industrial ponds at the EMF facilities. No attempt was made by Jacobson to characterize the nature of the impact.

1.3.1.2 Groundwater

This section briefly discusses previous investigations of groundwater chemistry, based on data collected during the following studies:

- Perry et al., 1990
- Jacobson, 1982, 1984, and 1989
- Goldstein, 1981

Water chemistry data were collected from various springs along the Portneuf River and from 16 wells in the EMF study area. These wells are identified in Figure 1.3-3.

The studies concluded that most of the wells belong to a calcium-bicarbonate system. Furthermore, most of these wells were found to be comparable to one or more of the four spring groups identified by Perry et al. (1990) (Section 1.3.1.1). Eight wells were found to have water chemistry comparable to the Papoose System: Papoose Springs Fish Farm, Pumping Station, New Pilot House, Idaho Power, Michaud/USGS-1, FMC-3, Williamsen, and Tank Farm wells. Two wells were comparable to the Swanson Road System: Rowland and Carlson wells. One well was comparable to the Batiste System: SWP-4. One well was intermediate between the Batiste and Papoose systems: SWP-5. The Perry study likened two wells, Lindley and FMC-1, to a Batiste/Papoose System, with increased levels of chloride. One well, Crockett, was not comparable to any of the four spring groups, but was comparable to the sodium chloride water chemistry of Willow Spring. One well, Old Pilot House, was not comparable to any spring and had a sodium/potassium carbonate water chemistry.

1.3.2 Identification of Constituents in Batiste Spring

This section addresses Batiste Spring (Figure 1.3-1) since it is the only spring identified by previous investigations (e.g., Perry et al., 1990, and Goldstein, 1981) as being impacted by anthropogenic activities at the EMF facilities. Previous investigations conducted at Batiste Spring are as follows:

- Perry et al., 1990.
- Goldstein, 1981 — The final report also referenced a 1979 report on a previous study conducted by Balmer and Noble of water resources for the Fort Hall Indian Reservation, including Batiste Spring.
- U.S. Geological Survey (USGS), 1977 — Batiste Spring was addressed in an environmental impact statement (EIS) prepared by the USGS.
- E&E, 1988.

Both the Perry and Goldstein studies showed increased sulfate, calcium, and nutrient concentrations at Batiste Spring relative to the other springs studied. Water quality of Batiste Spring was described by Balmer and Noble (Goldstein, 1981) as showing an increase in levels of hardness, chloride, sulfate, phosphate, nitrate, and ammonia from 1930 through the 1970s. The report also found fluctuating concentrations of mercury, arsenic, and cadmium in Batiste Spring in the 1970s.

Additional investigations identified elevated levels of phosphate in Batiste Spring (USGS, 1977; E&E, 1988). The phosphate levels were attributed to discharges to the Portneuf River from the EMF facilities.

A more comprehensive discussion of these previous investigations is provided in Appendix A of this report.

1.3.3 Identification of Constituents in Groundwater

Previous investigations that examined constituents in groundwater are as follows:

- Goldstein, 1981 — The final report also referenced a 1979 report on a previous study conducted by Balmer and Noble of water resources for the Fort Hall Indian Reservation, which included groundwater.
- Jacobson, 1982, 1984, and 1989.
- E&E, 1988.

These previous investigations reported the presence of elevated levels of metals and some general water quality parameters in groundwater.

The Goldstein and Jacobson studies attributed the elevated parameters in the Crockett well to the EMF facilities. The E&E investigation also found elevated concentrations of metals in the wells examined; furthermore, the study correlated the findings with some potential sources at the EMF facilities.

The EMF site was placed on the National Priorities List (NPL) on the basis of E&E's findings.

Further details on these investigations are presented in Appendix A.

1.3.4 Identification of Constituents in Surface Water and Sediments

This section summarizes the results of previous investigations of constituents in surface water and sediments of the Portneuf River. This discussion is based on the following previous investigations:

- Surface water quality was examined by Ecology Consultants (1977) and Campbell et al. (1992).

- Perry (1977) studied the impacts of effluent discharges from various sources on the Portneuf River.
- Mazanowski (1992) attempted to characterize sediment quality with respect to heavy metal concentrations for the Portneuf River sediments.

The locations of surface water and sediment sampling points included in these studies and, for reference purposes, RI surface water and sediment sampling points are shown on Figure 1.3-4.

The presence of elevated nutrients in surface water was investigated by Ecology Consultants and Campbell et al. The Ecology Consultants study found an increase in nutrient concentrations at stations 4 and 7 (Figure 1.3-4), based on samples collected in August 1977.

The Campbell investigation included a comparison of data collected in 1972 and 1991-1992, from locations indicated in Figure 1.3-4. The study concluded that while some stations showed decreased phosphate levels, overall phosphate levels in the river had not changed over the 20-year period. Campbell reported that increased phosphate levels found at one station were possibly attributable to the Pocatello Sewage Treatment Plant (STP) (Figure 1.3-1), Batiste Spring, or "gradual saturation of the river bottom sediments with phosphates as a result of eutrophication".

The 1977 Perry study presented the results of a water quality sampling program to characterize effluent impact on the Portneuf River. (See Figure 1.3-4 for sampling locations.) The sampling program concluded that the surface water quality was impacted during the period of the study as a result of operations at the EMF facilities, as well as the STP, Batiste Springs Fish Farm, and Papoose Springs Fish Farm.

The 1992 Mazanowski study attempted to quantify four heavy metals (cadmium, copper, lead, and zinc) associated with the clay-silt fraction of sediment from the Portneuf River. The locations of samples collected for this effort are shown on Figure 1.3-4. The investigation found metal concentrations above mean concentrations within the study area.

1.3.5 Ecological Investigations

This section summarizes the results of previous investigations of the EMF study area ecology. These investigations included aquatic surveys of the Portneuf River and studies of terrestrial wildlife and habitats. Additional information on investigations addressed in this section is provided in Appendix A.

1.3.5.1 Aquatic Surveys

Aquatic surveys of Portneuf River that were conducted in the past are as follows:

- Minshall and Andrews, 1973
- Buikema, 1975
- Ecology Consultants, 1977
- City of Pocatello, 1989

Surveys of aquatic ecology were conducted from the late 1960s to the mid-1970s. Because of the changes in discharge practices at the EMF facilities and other conditions in the river since that time, the data provided by the surveys may have limited relevance to the EMF site characterization study. The most recent aquatic ecology investigations of the Portneuf River are summarized in Section 3.7.

Aquatic surveys were conducted by Minshall and Andrews (1973) over the approximately 98-mile (157-km) long course of the Portneuf River. The study examined the distribution of benthic invertebrates along the stream course. The investigation indicated the possibility of toxic conditions below the EMF facility discharges. The 1975 Buikema survey examined the macrobenthos in the Portneuf River, along an approximate 655-foot (200-m) stretch of the river above and below the FMC and Simplot facility outfalls. Generally, the Buikema data obtained downstream from the effluents showed no major impact of these outfalls on the benthos. Another aquatic survey, prepared by Ecology Consultants (1977), addressed benthic fauna as well as attached algae (periphyton). The study concluded that the discharges had an effect upon most of the aquatic parameters studied.

Aquatic habitat between I-86 and Siphon Road was investigated by the City of Pocatello (1989) to evaluate possible effects of treated wastewater on the biology and chemistry of the Portneuf River. The area of focus for the bioassessment was the Portneuf River in the immediate vicinity of the STP's outfall. Sampling sites were selected above the outfall, within the mixing zone, and downstream from the mixing zone. Two seasonal sampling periods (autumn 1988 and summer 1989) were specified for the bioassessment. The study concluded that the ammonia-nitrogen load contained in the STP's effluent increased the ammonia content of the Portneuf River below the Roland creamery, and that a zone along the west bank of the river appeared to have been impacted minimally by the STP's effluent. The report further concluded that results of taxanomic analysis of benthic samples suggest that there is environmental stress associated with the effluent discharged from the STP.

1.3.5.2 Terrestrial Investigations

Previous investigations regarding terrestrial wildlife and habitats are as follows:

- State of Idaho and Others, 1965 - 1992
- Henny and Burke, 1990
- Low and Mullins, 1990
- Severson and Gough, 1979

The Department of Health and Welfare, Division of Environment Quality, State of Idaho directed studies of fluoride levels in vegetation to be conducted in the area surrounding the EMF facilities from the late 1960s to 1992. These investigations were conducted by the University of Idaho, Department of Agricultural Biochemistry and Soils (1965-1971), Department of Bacteriology and Biochemistry (1972-1980), and by Miller (1986-1987, 1990-1992). One shortcoming of these investigations is that the species collected for the study were not identified. Specifically, in many cases it could not be clearly determined from the data presented whether the plants sampled were annuals or perennials. Therefore, conclusions could not be made regarding the relationship of fluoride deposition and uptake by wildlife feeding on the vegetation and, hence, none are presented here.

Similarly, the results of the Henny and Burke (1990) study, which documented fluoride concentrations in black-crowned night herons, are not discussed in this section. The herons evaluated were not year-round residents and migrated to Mexico, where they were potentially exposed to other chemical constituents, such as the pesticide DDT. In addition, the study itself concluded that further research was needed to distinguish age effects from fluoride effects in wild avian populations.

Low and Mullins (1990) conducted a reconnaissance investigation of water quality, bottom sediment, and biota associated with irrigation drainage in the American Falls Reservoir area from 1988-1989. The purpose of the study was to determine whether potentially toxic compounds associated with irrigated drainage existed in surface, groundwater, bottom sediment, aquatic plants, benthic invertebrates, fish, and waterbirds in the American Falls Reservoir area. The authors concluded that, based upon general observations on health and diversity of biota during the field season, the study area did not appear to have a serious avian reproductive, habitat destruction, or food-chain biomagnification problem that could be associated with irrigation drainage.

Severson and Gough (1979) conducted a study in May 1975 to assess potential impacts of emissions from the EMF facilities on sagebrush and grasses. Vegetation samples were collected from distances of up to 40 miles (64 km) upwind (to the south) and downwind (to the north) of the facilities, and analyzed for 70 elements. The authors concluded that seven elements (cadmium, chromium, fluorine, selenium, uranium, vanadium, and zinc) were related to emissions from the EMF facilities. The study also found a correlation between constituent concentrations in the plants and distance from the facilities. The study relied on linear regression analysis of element concentrations measured along transects emanating from the facilities to assess whether individual element concentrations were associated with the facilities. The paper did not attempt to assess the spatial extent of impact.

1.3.6 AIR QUALITY

This section discusses previous air quality investigations conducted at the EMF study area. Over the past 20 years, ambient air quality monitoring has been performed by the State of Idaho and the FMC and Simplot facilities. The monitoring was performed to ascertain and monitor regional and local trends in ambient air quality, and focused on state and federal ambient air quality standards.

Historically, monitoring has been conducted for total suspended particulate (TSP) matter, particulate matter whose size is less than 10 microns (PM_{10}), sulfur dioxide (SO_2), and fluorides. The following are brief descriptions of the monitoring programs corresponding to each parameter.

1.3.6.1 Particulate (TSP and PM_{10}) *Monitoring*

Particulate monitoring for TSP at the EMF facilities began in 1971-1972, when the State of Idaho installed TSP monitors at the Pocatello STP. This equipment was later augmented by PM_{10} monitors in 1986. In 1988, PM_{10} monitors were also installed at locations 3 to 4 miles from the Simplot facility. In addition, FMC has conducted a program of particulate (TSP) monitoring since 1975 (enhanced with PM_{10} monitors in 1984), with the installation of two monitors within the facility boundaries, and a third about 50 feet away from the monitor at the Pocatello STP.

As a result of these monitoring programs, the EMF study area was identified as part of a TSP nonattainment area, and later, part of the PM_{10} nonattainment area.

1.3.6.2 Sulfur Dioxide (SO_2) Monitoring

Ambient SO_2 monitoring has been conducted by Simplot since 1978. Simplot has operated SO_2 monitors at the following locations: the Pocatello STP; north of the Rowland creamery; the vicinity of the Simplot water treatment ponds; in Chubbuck, approximately a quarter mile (0.4 km) from Rio Vista; approximately 1 mile (1.6 km) south-southeast of the Pocatello STP SO_2 monitor, coincident with the site 1 meteorological station at Simplot's surge pond; and a quarter mile (0.4 km) east of the Pocatello STP on Batiste Road. This last location was added in 1986 because the area was identified by atmospheric dispersion modeling as the calculated point of maximum SO_2 concentrations impacting on local elevated terrain.

Data from these monitoring stations indicated that SO_2 emissions from all sources are well under the threshold concentrations specified by state and federal ambient air quality standards.

1.3.6.3 Fluoride Monitoring

Under state of Idaho air quality rules, fluoride levels in forage material are required to be monitored. Forage fluoride sampling has been conducted in the area since the 1950s.

Historically, elevated levels of forage fluoride have been observed in the immediate vicinity of the FMC and Simplot facilities. Plants from areas having the highest fluoride readings typically are east and southeast of the facilities. Vegetation in these areas is sparse, consisting primarily of sagebrush and scrubgrass.

1.3.6.4 Airborne Deposition and Soils Impacts

In May 1975, Severson and Gough (1979) conducted a survey for the USGS to assess potential impacts of emissions from phosphate-processing facilities to offsite soils. Samples were collected from distances up to 40 miles (64 km) upwind (to the south) and downwind (to the north) of the facilities. Surficial soil samples were collected at a depth of about 5 cm.

Subsurface samples were generally collected at a depth of 80 to 100 cm, though at places where the underlying rock was near the surface, samples were as shallow as 50 cm.

The study reported that 9 of 58 elements measured in surficial soils were related to EMF facility operations. The nine constituents were beryllium, fluorine, iron, lead, lithium, potassium, rubidium, thorium, and zinc. However, the study did not find a correlation between element concentrations in subsurface soils and the EMF facilities. The general observation that some elements in the surficial soils appeared to be related to the facilities whereas elements in the subsurface soils did not is consistent with findings of the RI (Section 4.3).

1.3.7 FMC FACILITY INVESTIGATIONS

Previous investigations conducted at the FMC facility are as follows:

- Geraghty and Miller, Inc., 1982a and 1982b
- FMC, 1991b

G&M reviewed groundwater analytical data from the FMC onsite wells, offsite wells, and nearby springs to determine the effect of FMC's operations on groundwater quality. Nineteen monitoring wells were installed, and groundwater samples were collected at quarterly intervals from August 1980 through November 1981. G&M reported elevated total dissolved solids concentrations extending from Pond 7E (Figure 1.1-1) to the Portneuf River, as well as a smaller warm water plume suspected of being caused by the slag operation. The total dissolved solids plume followed the groundwater flow and discharged into the Portneuf River through a series of small springs on the west bank of the Portneuf River, two of which are Swanson Road Spring and Batiste Spring (Geraghty and Miller, Inc., 1982a and 1982b).

An FMC Facility Assessment (FFA) was also conducted from September to December 1990 (FMC, 1991b). The FFA further characterized the hydrogeologic conditions and established a groundwater monitoring program to comply with applicable RCRA requirements. The field investigation conducted in 1990 included collection of one round of groundwater samples, surface soil samples, and subsurface soil samples.

The hydrogeologic investigation consisted of the following:

- Installation of 36 onsite wells
- Collection and analysis of groundwater samples
- Aquifer testing
- Measurement of groundwater levels

Groundwater samples were collected from each of the newly installed wells immediately after development, and from 28 onsite and offsite existing wells. The locations of wells sampled during the FFA are shown in Figure 1.3-5. Wells installed by Geraghty and Miller, Inc., (G&M) are identified with a "TW" prefix; wells installed in 1990 are numbered 101 to 137; and wells currently or previously used as facility production wells are identified with the prefix "FMC." Named wells are private water supply wells.

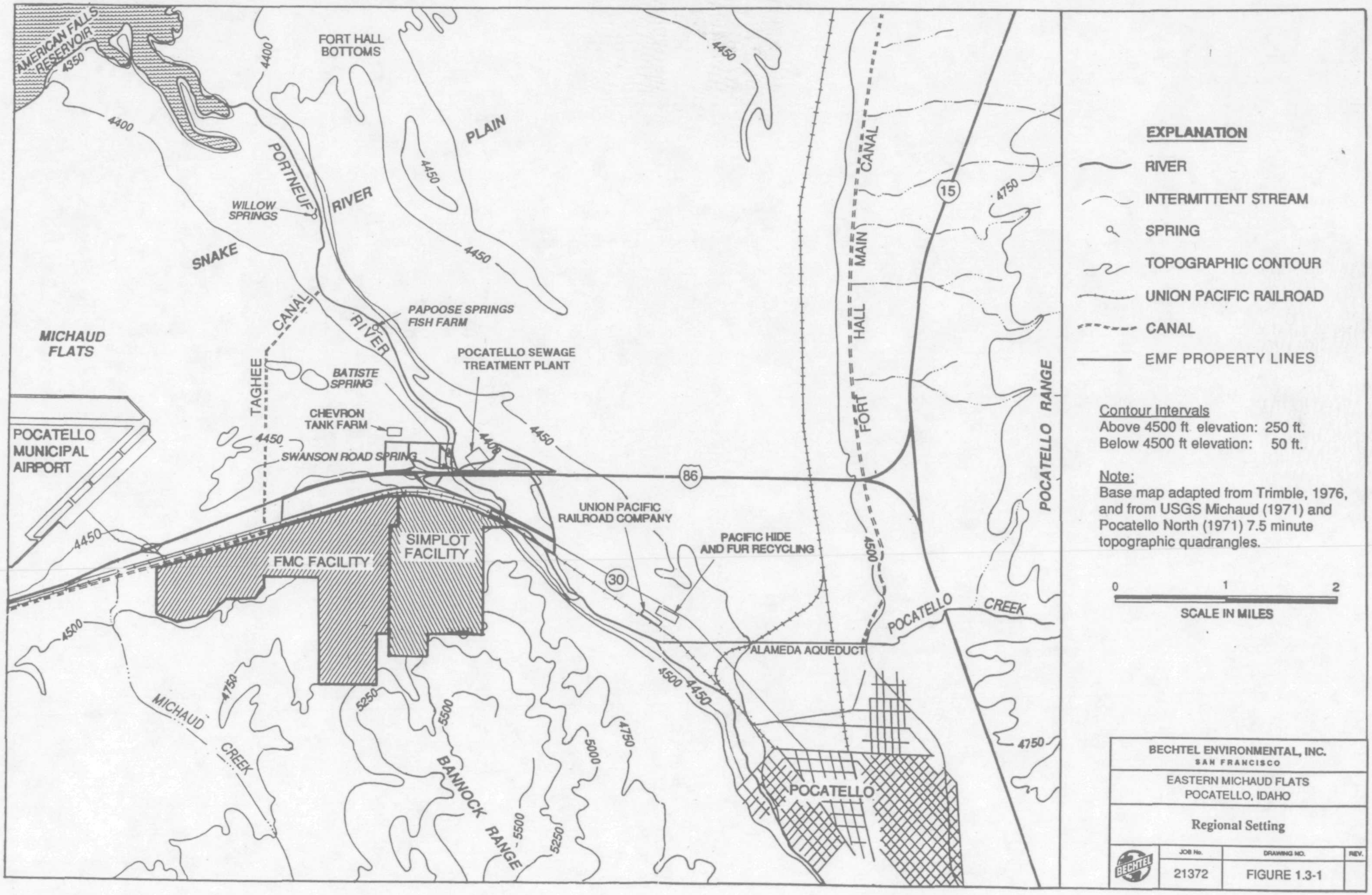
The FFA identified three areas where the distribution of constituents in groundwater were elevated within the FMC facility boundary. Three dissolved constituents (arsenic, nitrate, and selenium) were found to be at elevated levels. In addition, dissolved constituents (iron, lead, manganese, potassium, sodium, alkalinity, chloride, fluoride, sulfate, total dissolved solids, total phosphorus, and orthophosphate) were detected in underlying shallow groundwater at levels higher than the background levels identified by G&M as characteristic of the area. Elevated levels were restricted to the uppermost (shallow) interval.

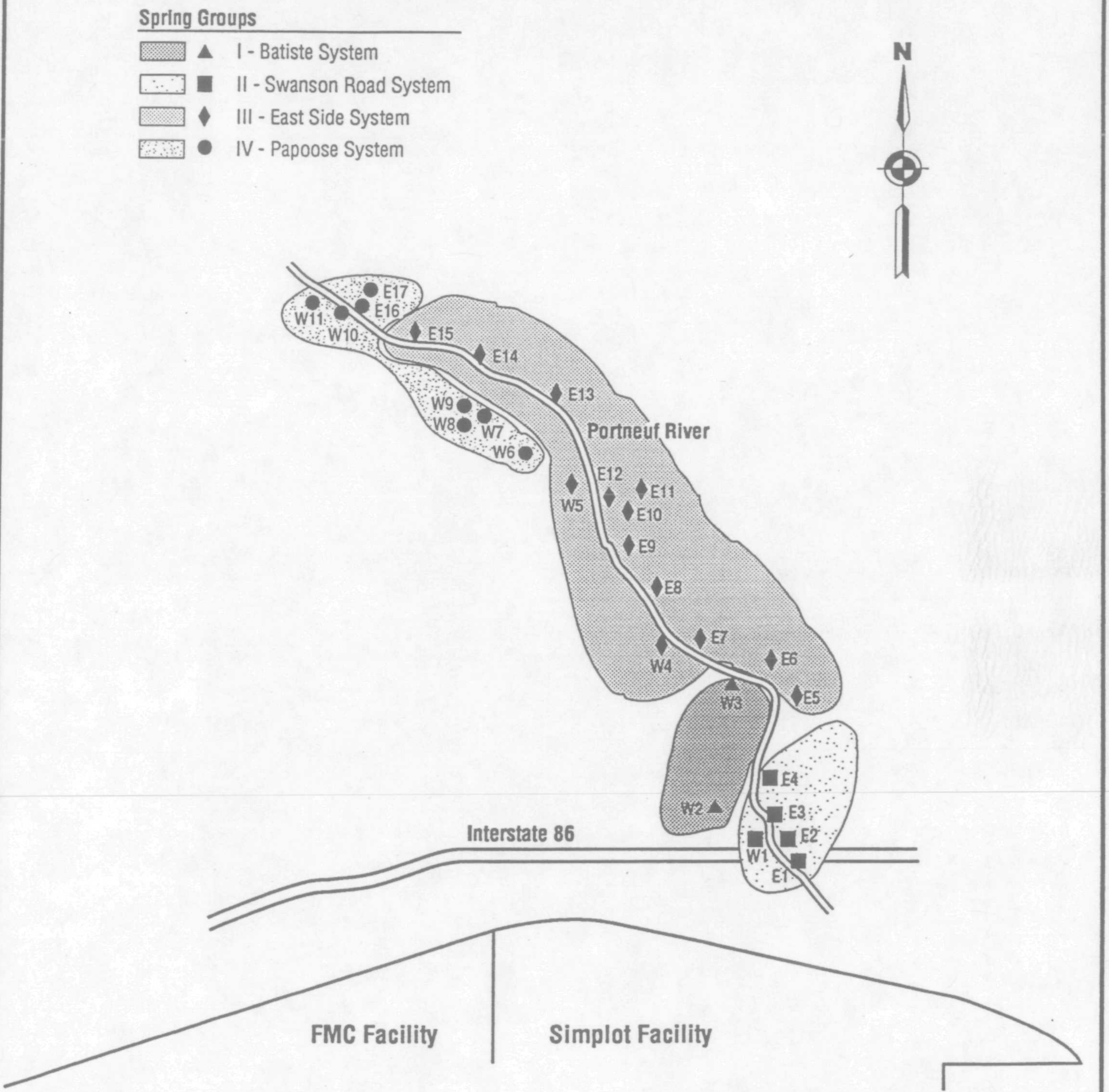
During the FFA, 12 surface soil samples and 105 subsurface soil samples were also collected. In the surface soils samples, nine parameters (cadmium, chromium, lead, silver, vanadium, zinc, fluoride, total phosphorus, and orthophosphate) were detected at concentrations above background. In the subsurface soils samples, arsenic, cadmium, zinc, fluoride, orthophosphate, and total phosphorus were detected at elevated concentrations.

1.3.8 Simplot Facility Investigations

In 1984, PEDCo Environmental, Inc. (PEI), under contract to the EPA, installed six monitoring wells at the Simplot facility. The PEI (1985) investigation detected low levels of arsenic and cadmium concentrations in groundwater. Low concentrations of barium, chromium, lead, vanadium, and zinc were also detected in the groundwater samples. Wells with the prefix "PEI" were installed during these investigations. Wells with the prefix "SWP" are Simplot facility production wells.

Surface and Subsurface Characterizations
Figures for Section 1.3


AMERICAN FALLS RESERVOIR
FORT HALL BOTTOMS
PLAIN
PORTNEUF
RIVER
WILLOW SPRINGS
SNAKE
CANAL
TAGHEE
PAPOOSE SPRINGS FISH FARM
RIVER
MICHAUD FLATS
BATISTE SPRING
POCATELLO SEWAGE TREATMENT PLANT
CHEVRON TANK FARM
SWANSON ROAD SPRING
POCATELLO MUNICIPAL AIRPORT
FMC FACILITY
SIMPLOT FACILITY
UNION PACIFIC RAILROAD COMPANY
PACIFIC HIDE AND FUR RECYCLING
ALAMEDA AQUEDUCT
POCATELLO CREEK
FORT HALL MAIN CANAL
POCATELLO RANGE
MICHAUD CREEK
BANNOCK RANGE
POCATELLO
86
30
15
4350
4400
4450
4500
4750
5000
5250
5500
EXPLANATION
RIVER
INTERMITTENT STREAM
SPRING
TOPOGRAPHIC CONTOUR
UNION PACIFIC RAILROAD
CANAL
EMF PROPERTY LINES
Contour Intervals
Above 4500 ft elevation: 250 ft.
Below 4500 ft elevation: 50 ft.
Note:
Base map adapted from Trimble, 1976, and from USGS Michaud (1971) and Pocatello North (1971) 7.5 minute topographic quadrangles.
0
1
2
SCALE IN MILES
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Regional Setting
JOB No.
DRAWING NO.
REV.
21372
FIGURE 1.3-1



Note:
Modification of map by Perry et al. (1990) showing location of springs, with the four "spring groups" defined with cluster analysis of water chemistry.

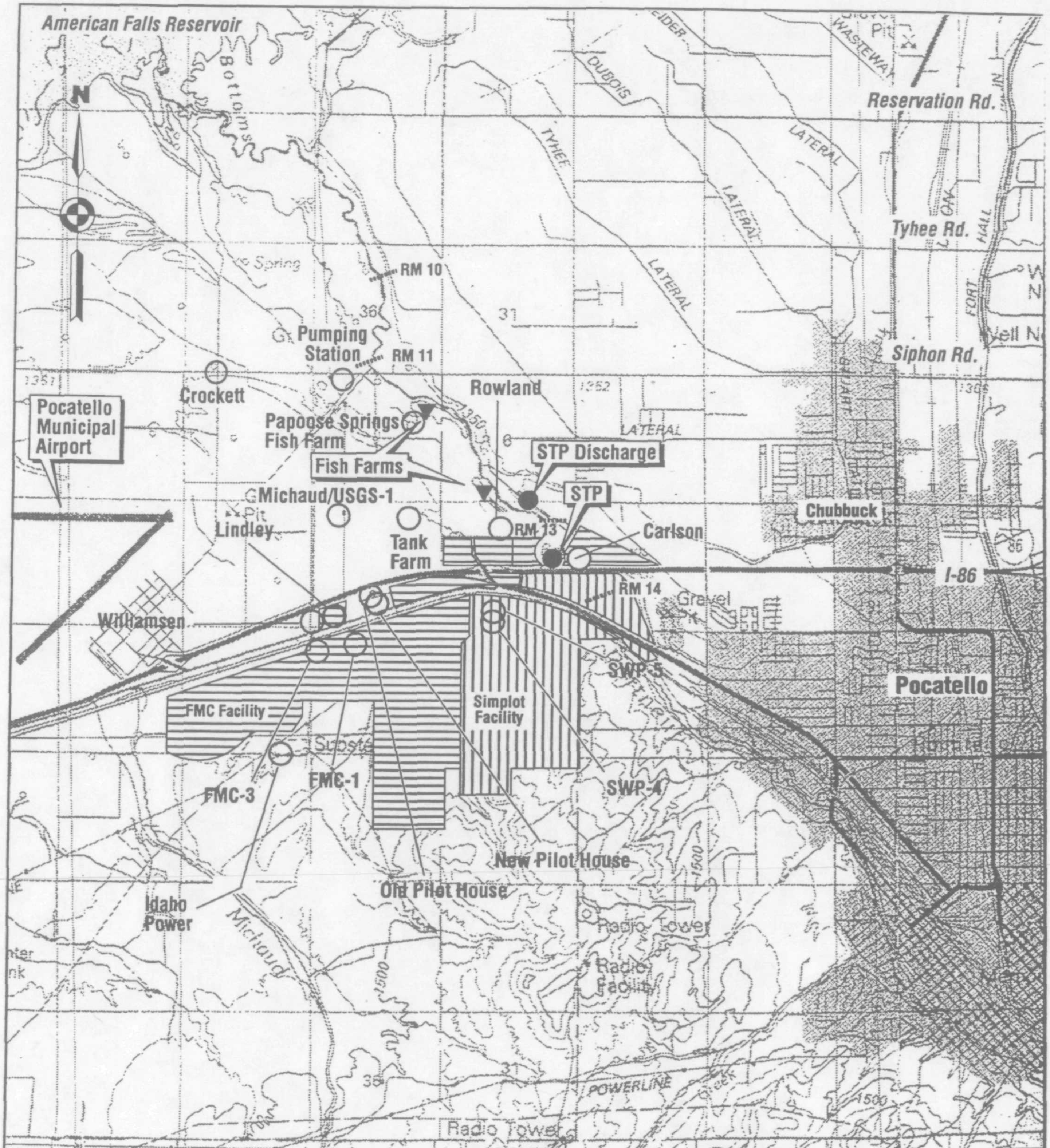
Scales

0 — 1 mile

0 — 1 — 2 kilometers

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Location of Spring Groups on Portneuf River		
JOB No.	DRAWING NO.	REV.
21372	FIGURE 1.3-2	

93-1477b.007 m2



Legend:

STP	Pocatello Sewage Treatment Plant
RM	River Mile
○	Location of well sampled
	FMC Property
	Simplot Property

0 1 2 miles

0 1 2 3 kilometers

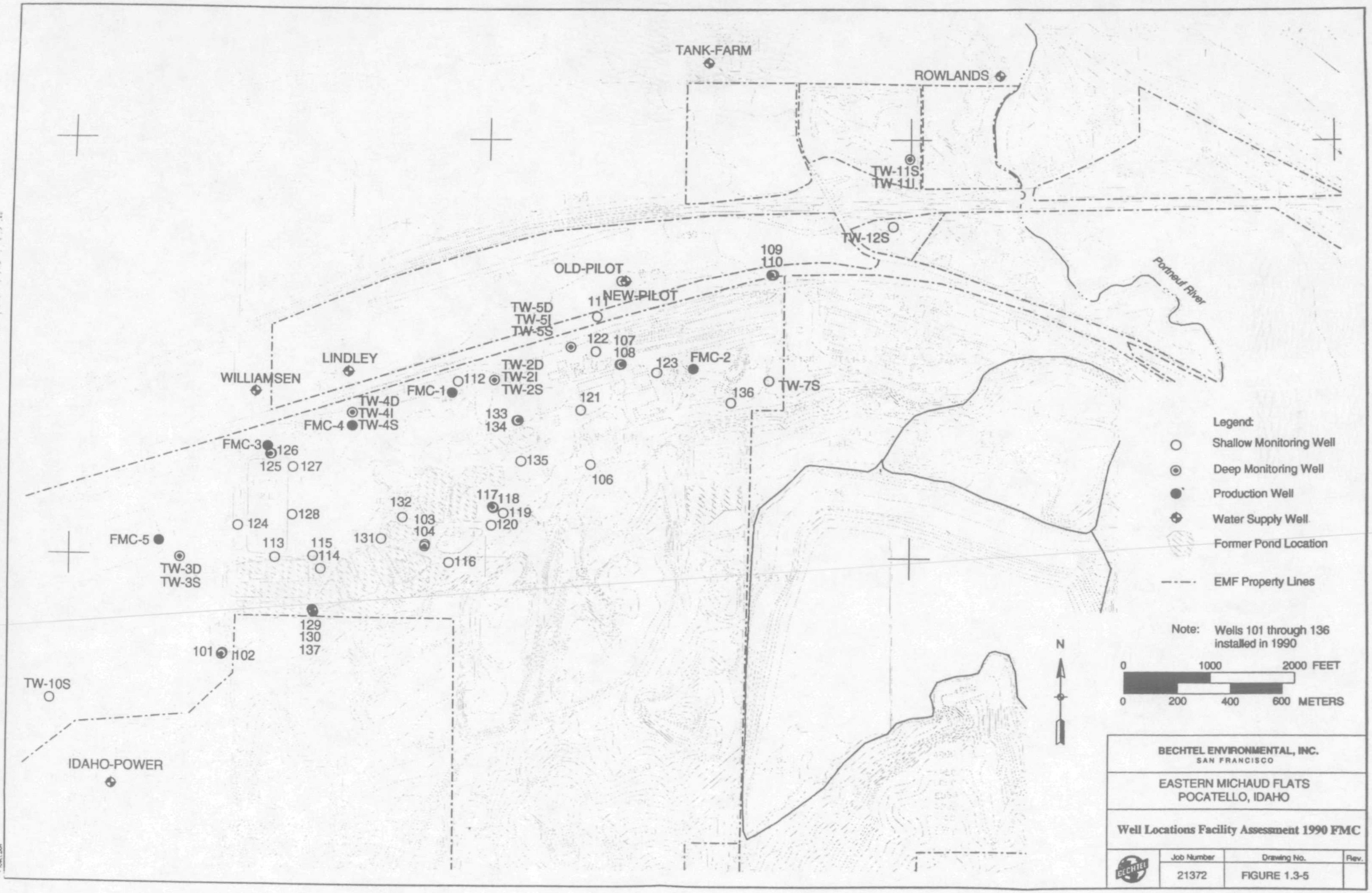
95-1129b.005 m3
9-6-95 lw/rs :10

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Location of Wells Sampled During Previous Investigations

JOB No.	DRAWING NO.	REV.
21372	FIGURE 1.3-3	0



TANK-FARM
ROWLANDS
TW-11S
TW-11I
TW-12S
Portneuf River
109
110
OLD-PILOT
NEW-PILOT
111
TW-5D
TW-5I
TW-5S
122
107
108
123
FMC-2
TW-7S
136
LINDLEY
WILLIAMSEN
TW-2D
TW-2I
TW-2S
112
FMC-1
121
TW-4D
TW-4I
TW-4S
FMC-4
133
134
FMC-3
126
125
127
135
106
132
103
104
117
118
119
120
128
124
131
FMC-5
TW-3D
TW-3S
113
115
114
116
129
130
137
101
102
TW-10S
IDAHO-POWER
N
Legend:
Shallow Monitoring Well
Deep Monitoring Well
Production Well
Water Supply Well
Former Pond Location
EMF Property Lines
Note: Wells 101 through 136 installed in 1990
0 1000 2000 FEET
0 200 400 600 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Well Locations Facility Assessment 1990 FMC
Job Number
21372
Drawing No.
FIGURE 1.3-5
Rev.

Study Area Investigations

This section describes the field methods, data collection procedures, and analyses performed for the various phases of the RI. The findings of the RI are discussed in Sections 3 and 4.

The information presented in Section 2 is organized in terms of the media investigated:

- Potential source and facility soil investigation — Section 2.1
- Surface soil investigation — Section 2.2
- Hydrogeologic and geologic subsurface investigations — Section 2.3
- Surface water and sediment investigation — Section 2.4
- Land use and demography survey — Section 2.5
- Ecology survey — Section 2.6
- Ecological investigations — Section 2.7

For each investigation or survey, the field activity, sampling procedures, field quality control, and analyses performed are described. Analytical methods are described in the Precision, Accuracy, Representativeness, Completeness, and Comparability (PARCC) section of this report located in Appendix J. As with all large investigations, some deviations from protocols occurred. Such deviations are also discussed in Section 2.

Gamma radiation surveys performed for FMC and Simplot in the course of the RI are described in Attachments O-1 and O-2 of Appendix O. The attachments describe survey methodology and results.

Analytical Parameters

The list of selected analytes for each medium (e.g., soils, groundwater, surface water, sediment) was developed considering the following factors:

- Characteristics of the phosphate-bearing ore processed by the EMF facilities —The ore contains apatite, a mineral containing calcium, phosphate, and fluoride. The ore also contains trace levels of arsenic, cadmium, chromium, vanadium, zinc, uranium-238 and its daughters, and other naturally occurring elements.

- Historical data previously collected by FMC. FMC had tested some of its waste streams for the presence of RCRA-regulated constituents when the plant became subject to RCRA in 1990. Therefore, Phase I analytes for these waste streams consisted only of parameters for which tests were not previously performed.
- Preliminary list of constituents provided by the EPA in its Data Needs Document (E&E, 1991) — This list was incorporated directly into the Phase I RI parameters list with the following exceptions: asbestos, silica, rubidium, and certain radionuclides.
- Potential of parameters to migrate from a potential source via a given media pathway to a potential environmental receptor.

The analyte lists for the different media were essentially the same, with the exception of parameters that were specific only to a particular media (e.g., water quality parameters on water samples only).

Data Management

Data from field observations and environmental sample analysis are stored in a database designed to comply with the EPA Region 10 data-handling requirements. Separate files within the database store information on the sampling locations, groundwater elevations, and sample analysis results. The tables contain keys and indexes that allow the various files to be used relationally.

Sample analysis results for individual sample matrices such as soils, groundwater, surface water, and vegetation sampling are stored in separate tables. Results of radiological analyses for each matrix are stored in separate files. Each record of an analysis contains a field indicating the level of validation and a data qualifier as appropriate. Field measurements, such as temperature, are stored in the sample analysis results tables; field data were not validated.

Analytical results were reviewed for accuracy prior to incorporation into the database. All data were reviewed for transcription errors as well as contract compliance screening, and for consistency with other data obtained from the site. Where inconsistencies were found, the affected data were subjected to full Data Quality Objectives (DQO) Level IV validation (i.e., review of chain of custody, analysis laboratory notes, calculations, instrument printouts, and calibration information) to determine the quality of the data. Where the data were consistent with other site data, 10 percent of the sample delivery groups were subjected to full validation. Data issues raised by consistency checks and data validation were tracked. All changes to data made after loading the data transmittal from the laboratory were tracked. A complete description of the database may be found in "RI/FS Data Dictionary for the Eastern Michaud Flats Site" (Bechtel, 1993d). Further discussion of data validation results is provided in Appendix J.

2.1 POTENTIAL SOURCE AND FACILITY SOIL INVESTIGATION

The potential source and facility soil investigation was conducted to evaluate hypotheses relevant to the conceptual site model presented in the RI/FS Work Plan (Bechtel, 1992b). These hypotheses were developed from knowledge of historic and present product and by-product handling operations and previous site investigations. The sampling program was developed to investigate areas which historic data and current plant operations indicated were most likely to have been potential sources of releases or where placement of raw materials or by-products would have occurred.

Sample collection procedures and analytical parameters are described in Section 2.1.1. Materials that may have impacted various media listed above are addressed in Section 2.1.2 for the FMC facility and in Section 2.1.3 for the Simplot facility.

2.1.1 Sampling and Analysis Procedures

The following section describes the documentation, sampling, and decontamination procedures used during Phase I and Phase II of the potential source and facility soil investigation.

2.1.1.1 Field Documentation

Sample custody procedures were followed through sample collection and transfer to ensure that the integrity of samples was maintained. All samples were collected in accordance with EPA chain-of-custody guidelines as prescribed in EPA National Enforcement Investigation Center (NEIC) Policies and Procedures (EPA, 1984a). Field sampling personnel maintained field log books and chain-of-custody records containing the following information:

- Sample identification numbers
- Sample collection dates and approximate times
- Sample matrix
- Sample location and depth

- Sample appearance
- Sample field measurements (if applicable)
- Sample preservatives (if applicable)
- Type of sampling equipment used
- Type and number of sample containers
- Sampler's name(s)
- Custody seal number(s)

A sample label was affixed to each individual sample collected. The following information was recorded on each label:

- Project name and location
- Project number
- Date
- Time
- Sampler's initials
- Sample identification number
- Analysis required and preservative used

A custody seal, signed and dated, was also affixed to each sample collected. Chain of custody was maintained using a multi-ply version of the chain-of-custody form included in Appendix A of the RI/FS Sampling and Analysis Plan (SAP) (Bechtel, 1992a). These forms accompanied the samples from the field to the laboratory.

2.1.1.2 Sampling Procedures

The sampling procedures followed during the potential source and facility soil investigation are described below for each medium sampled.

Solid and Liquid Material, Surface Water, and Sediment Samples

Samples were collected with stainless steel trowels, shovels, sediment samplers, hand augers, or laboratory-cleaned collection jars. Phossy water and precipitator slurry samples containing elemental phosphorus were sampled from sampling ports by FMC personnel.

Typically, the samples collected were grab samples. However, collection of location- or time-composite samples was occasionally warranted, depending on the nature of the material that was to be tested. Location-composite samples were collected if the material was largely homogeneous (e.g., contents of active surface impoundments). On the other hand, concern with variable material characteristics (e.g., flow rates, chemical composition) resulted in time-composite sampling.

Where collection of location-composite samples was required, samples were obtained from either the four corners or from the centers of the four sides of the unit, in equal amounts. The samples were subsequently composited into one sample.

Time-composite samples consisted of four grab samples taken at the same location at 6-hour intervals within a 24-hour period. These samples were then composited into one sample.

Shallow Soil and Road Samples

Shallow soil samples were collected using stainless steel garden trowels, shovels, or hand-driven augers, or with a hollow-stem auger rig with a modified California split-spoon sampler. Samples were collected from the soil surface at a depth of approximately zero to 2 inches below asphalt, gravel, or road base, and at a depth of 2 feet below ground surface, if possible. Each sample was obtained with properly decontaminated equipment and transferred into a precleaned widemouthed glass jar.

Subsurface Soil Samples

Subsurface soil samples were collected in selected areas for chemical analysis using the dual-wall percussion/hammer or rotary drilling method as applicable. The methods used during subsurface soil sampling were identified on geologic boring logs maintained during drilling activities. Details of the sample, such as color, lithology, texture, bedding, cementation, grain size distribution, structure, consistency, density, and moisture were also recorded on a geologic log form. (See Appendix A of the RI/FS SAP for sample form [Bechtel, 1992a].)

Subsurface soil sampling was conducted to one of two alternative depths: (a) to 10 feet below fill or (b) to groundwater or bedrock. The criterion used for depth location was the presence of a hydraulic driving force at the area. Specifically, if the area to be drilled was known to have had an applied hydraulic head in the past (e.g., former ponds) or was observed to contain liquid materials at the time of sampling, the area (or vicinity) was sampled to groundwater or to refusal. Samples were collected to 10 feet in areas not subject to applied hydraulic head other than natural precipitation.

The subsurface samples were collected in brass liners using a modified California sampler. The soil sample was obtained with properly decontaminated equipment and transferred into a precleaned widemouthed glass jar.

2.1.1.3 Decontamination of Sampling Equipment

All equipment that came into contact with potentially contaminated soil, drilling fluids, or water was decontaminated. Sampling equipment was either cleaned at the drilling or sample location, or was steam-cleaned along with other equipment at a decontamination station. Trowels and samplers were steam-cleaned or washed with a nonphosphate detergent scrub, followed by fresh water and deionized water rinses. Equipment was decontaminated over plastic sheeting or other containment, and clean equipment was stored on plastic sheeting or packaged in plastic bags.

Containerized decontamination fluids were transferred to FMC's and Simplot's ponds, as appropriate.

2.1.1.4 Chemical and Radiological Analyses

Potential source and facility soil samples were analyzed for the parameters listed in Tables 2.1-1 and 2.1-2. Mountain States Analytical, Inc. (MSAI) of Salt Lake City, Utah, performed the chemical analyses. General Engineering Laboratories (GEL) of Charleston, South Carolina, performed the radiological analyses. Analyses were performed in accordance with the RI/FS Work Plan and the SAP (Bechtel, 1992a and 1992b), unless otherwise indicated in Appendix J.

2.1.2 FMC AREAS OF INVESTIGATION

FMC potential source areas, including areas that may have been potential sources in the past, are listed in Table 2.1-3 and are shown in Figures 2.1-1 and 2.1-2. Table 2.1-3 also provides the sampling rationale, media sampled, sample depths, number of locations, sample intervals, and analytes tested in each area of the FMC facility. Sample identification numbers for the Phase I and Phase II samples collected during the investigation are included in this table.

2.1.2.1 FMC Process Sources

This section describes potential sources related to FMC processes.

Phosphate Ore

Phosphate ore, the primary raw material for the production of elemental phosphorus at the FMC facility, is the material from which metals, radionuclides, and other trace elements found in FMC wastes are originally derived. Consequently, a composite sample of the ore (FOSFPO01) was collected with a hand trowel from the southern ore pile, shown in Figure 2.1-2. The sample was analyzed for the inorganic and radiological parameters specified in Table 2.1-1 to confirm the appropriateness of the analytical parameter list.

Wastewater and By-products

FMC wastewater and by-product streams that are discharged to active units, such as ponds, were sampled and analyzed. These were as follows:

- Water in the railroad swale (FWWRRS01, location-composite) from stormwater runoff
- Water discharged to the calciner ponds (FSWCPW01, time-composite) from plant operations
- IWW ditch discharge to the Portneuf River (FSWIWW01) from industrial wastewater
- Phossy water discharged to the lined Phase IV ponds (Ponds 11S through 14S) and indirectly to Ponds 15S and 8S (FSWPWSIV, time-composite)
- Precipitator slurry discharged to lined Ponds 8E and 9E (FSWPS88E, time-composite)

All samples, except those containing elemental phosphorus, were collected using laboratory sample containers. Samples containing elemental phosphorus were collected in a metal bucket for safety considerations and subsequently transferred into glass sample containers. Field parameters for the above samples are presented in Table 2.1-4.

Based on the findings of the Phase I investigation of the IWW ditch discharge, a more detailed evaluation was conducted as part of Phase II. Fourteen 24-hour composite samples were obtained over a 2-week period; of these, six (representing the three highest and three lowest flowrates) were selected for analysis. Analytical parameters for these samples are listed in Table 2.1-2. Sample identifiers and field parameters are presented in Table 2.1-5.

Sediments and sludges at the site that came into contact with the waste streams identified above were also collected and analyzed. These samples were:

- Railroad swale (FSDRRS01, location-composite)
- Calciner ponds (FSDCPW01, location-composite)
- IWW ditch (FSDIWW01 through FSDIWW05)
- IWW basin (FSDIWW06, location-composite)

- Pond 15S (FWSP1501, location-composite) and Pond 8S (FWS8S01, location composite)
- Pond 9E (FWSP9E01, location-composite)

The following potential sources and by-products were also sampled:

- Slag from storage pile areas (FWSSSA01 through FWSSSA06)
- Ferrophos from storage pile areas (FWSFSA01 through FWSFSA03)

Slag, a by-product of furnace operations, is stored on the site in large piles south of the plant operations areas. Samples were collected with a hand trowel at six random locations shown in Figure 2.1-2. Samples were analyzed for the parameters listed in Table 2.1-1, including TCLP metals.

Ferrophos is an iron-rich by-product of furnace operations which is collected in sand molds and stored on the site. Ferrophos samples were collected with a hand trowel at three random locations shown in Figure 2.1-2. Samples were analyzed for the parameters listed in Table 2.1-1 including TCLP metals.

2.1.2.2 FMC Facility Soils

The FMC facility soil investigation was developed on the basis of historical data on types and locations of plant operations, by-product storage, wastewater handling and impoundments, current operations, source materials, by-products, and wastes, as described in Section 6.1 of the Work Plan (Bechtel, 1992b). The purpose of this investigation was to evaluate areas most likely to have been impacted by raw materials (e.g., ore), by-products, wastes, and wastewaters from former or present facility operations. Investigations of facility soils focused on these areas. The purpose of these investigations was to identify the extent to which impact may have occurred, and to evaluate the areas as possible secondary sources of constituents to the groundwater pathway.

The FMC boring and sample locations identified and discussed below are shown in Figure 2.1-1 unless otherwise stated. All samples were analyzed for the parameters listed in Table 2.1-1 unless otherwise indicated. Individual sample descriptions and actual sample depths are provided in Table 2.1-6.

Pond 8S. During the RI period of investigation, Pond 8S was an unlined pond containing phossy wastes from previous operations. Two borings (B12, B13) and one well (Well 150) were drilled in April 1992 at the perimeter of the pond area to characterize the soils in the vicinity of the pond. Soil samples were also collected at 10-foot intervals until groundwater was encountered at approximately 120 feet.

Three additional borings (F124B, F125B, F126B) were also drilled with a hand auger in the fall of 1992. Soil samples were collected at the ground surface and at a depth of 2 feet.

Former Calciner Ponds. The area occupied by the former calciner ponds (old Ponds 1C and 2C) is now the site of existing calciner ponds 3C and 4C. A boring (F023B) was drilled south of existing calciner pond 3C. In addition, soil samples were collected at the ground surface and at 10-foot intervals until the drill rig reached refusal at 72 feet.

Former Pond 4E. Former Pond 4E was located in the same general area as the existing Phase IV ponds. One boring (F024B) was drilled at this location to characterize the soils. Soil samples were also collected at the ground surface and at 10-foot intervals until groundwater was encountered at 76.5 feet.

Former Ponds 5E and 6E. Former Ponds 5E and 6E were located in the same general area as the existing lined pond, 15S. Soils data previously collected at these locations are presented in the FFA (FMC, 1991). To further characterize the soils in the area of these former ponds, one boring was drilled at the location of each former pond (F025B and F026B). Soil samples were collected at the ground surface and at 10-foot intervals until groundwater was encountered at 71.5 feet (Pond 5E) and 61.5 feet (Pond 6E). Sample recovery was hampered at both borings due to the sand and gravel matrix of the soil.

Active Landfill. The active landfill is located south of the slag pile. Potential impact of the active landfill on the soils in the vadose zone was evaluated by drilling one boring (F027B) in a location downgradient of this landfill. In addition, soil samples were collected at the ground surface and at 10-foot intervals until bedrock was encountered at 140 feet. No groundwater was encountered during the drilling of this boring.

Chemical Laboratory Seepage Pit. The chemical laboratory seepage pit beneath the main parking lot was used for the disposal of organic and inorganic chemical wastes from the laboratory prior to 1980. Two borings were drilled at this area, one south of the seepage pit (F029B) and one to the northeast (F028B). In addition, soil samples were collected at the ground surface, and at 10-foot intervals until groundwater was encountered at 71.5 feet for both borings. Sample recovery was hampered due to the soil matrix. Actual sample intervals are presented in Table 2.1-6.

Industrial Wastewater Basin/Ditch. The IWW basin is used to cool noncontact cooling water. The IWW ditch conveys wastewater from the basin to its discharge point at the Portneuf River. Soils in the area of the IWW basin and ditch were characterized by drilling a boring (F030B) near the outlet to the IWW ditch. Soil samples were also collected at 10-foot intervals until groundwater was encountered at 75 feet.

Boiler Fuel Tank and Pipeline Area. The boiler fuel tanks and pipeline contained fuel oil for operating the boilers. In May 1992, two borings (B14 and B15) were drilled in the area of the boiler fuel storage tanks and associated pipeline to a depth of 50 feet. Soil samples were also collected at the ground surface and at 5-foot intervals to a depth of 50 feet in boring B14 and 30 feet in boring B15 due to sample refusal. Samples were analyzed for the parameters listed in Table 2.1-1 including total petroleum hydrocarbons (TPH).

Former Pond 1E. Former Pond 1E was located in the same general area as the existing lined Ponds 8E and 11S. One boring (F033B) was drilled in the location of this former pond to characterize the soils in the area. Soil samples were also collected below the pond fill at 4.5 feet and at 5-foot intervals to a depth of 15 feet below fill.

Area 9S. Area 9S was a storage pile for dried precipitator dust, and has not been in use since July 1990. One boring (F034B) was drilled in the location of this former pond. Soil samples were collected at the ground surface and at 5-foot intervals to a depth of 15 feet below fill.

Old Precipitator Slurry Ponds (Ponds 00S, 0S, 1S through 7S, 9S and 10S). As discussed in the RI/FS Work Plan (Bechtel, 1992b), these ponds are inactive and the residual materials remaining at their former locations are likely to contain buried pockets of elemental phosphorus that could be exposed should these ponds be investigated.

These ponds were very similar in nature to Pond 8S. Methods of investigation and chemical analysis were developed that would provide safe sample collection and handling, and representative analytical results. However, even with the special conditions, this work was considered very hazardous, both in the field and the laboratory, and it is also extremely expensive.

Because all of the former unlined ponds were managed in the same general manner as Pond 8S, the effects in the subsurface should be similar. Therefore, it was proposed that the analysis of subsurface conditions done for Pond 8S be considered representative of subsurface conditions at all of these former precipitator slurry pond locations.

Pond 9S has been excavated and no longer contains waste.

Pond 10S was constructed with a single liner. There is no indication that the pond liner has been breached. Also, material that was placed in Pond 10S, although chemically similar to the other ponds, had a much lower water content, reducing the amount of fluid in the pond that could have entered the subsurface should a leak occur. As with currently active lined ponds, drilling within the pond area was not done so that the integrity of the liner would not be compromised.

To evaluate the effects of these ponds further, estimates were made of the volume of material placed in each pond. These estimates were made on the basis of the size of the pond, the duration of pond operation, and the production rates of the facility during that time period. These estimates are provided in Appendix M.

Old Phossy Water Ponds 2E and 3E. As discussed in the RI/FS Work Plan (Bechtel, 1992b), these ponds are inactive. The sediments from Pond 2E were excavated and placed in Pond 4E prior to construction of Pond 8E on this site. The sediments in Pond 3E were also excavated prior to the construction of the Phase IV ponds on this site.

Both of these former unlined ponds were managed in the same general manner as Pond 8S, and the subsurface effects should be similar. Therefore, it was proposed that the analysis of subsurface conditions conducted for Pond 8S be considered representative of subsurface conditions at all of these former phossy water pond locations.

To evaluate the effects of these ponds further, estimates were made of the volume of material placed in each pond. These estimates were made on the basis of the size of the pond, the duration of pond operation, and the production rates of the facility during that time period. These estimates are provided in Appendix M.

Old Phossy Water Pond 7E. This pond is inactive. Pond 7E was located west of Pond 6E. Pond 7E was an overflow evaporation pond, used only when the capacities of other evaporation ponds were exceeded during times of high precipitation and low evaporation. The water contained in Pond 7E was typically low in suspended sediment, having already passed through at least two other surface impoundments. The low sediment content of the water and the intermittent use of the pond led to very little accumulation of sediments. Regardless, FMC scraped the bottom of this pond and closed it in 1981. In June 1994, boring F162B was drilled through this old pond area and soil samples collected and analyzed to assess potential impacts to groundwater and soils from past operations of this pond.

Transformer Salvage Area. The transformer salvage area, located near inactive Pond 1S, was a storage area for used transformers. Two borings (F035B and F036B) were drilled in the area to evaluate existing soil conditions. Soil samples were collected below the road surface and at 2.5-foot intervals to a depth of 10 feet below fill. Samples were analyzed for the parameters indicated in Table 2.1-1 including polychlorinated bi-phenyls (PCBs).

The surface soils of F035B were resampled for PCBs during Phase II to assist in validating Phase I results.

Waste Oil Storage Area. A drum storage area for management of drummed heavy lube oil, sludges, and transformer oil overlies old Pond 2S. Two borings (F037B and F038B) were drilled in the location of the waste oil storage area to evaluate existing soil conditions. Soil samples were attempted below the fill (gravel/slag) and at 2.5-foot intervals to a depth of 10 feet below fill. Elemental phosphorus was encountered at multiple locations, and the borings were abandoned with one sample obtained. This sample was analyzed for the parameters indicated in Table 2.1-1 including PCBs and TPH.

Railroad Swale. The railroad swale is a ditch running along the railroad tracks at the north edge of the facility. This ditch receives stormwater runoff from the FMC property. The soils in this area were evaluated by drilling four borings (F039B, F040B, F041B, F042B) to a depth of 10 feet. Elemental phosphorus was encountered during drilling in one boring (F040B) in multiple locations; the boring was abandoned with two samples obtained. Soil samples were collected below fill (gravel/slag), at the ground surface, and at 2.5-foot intervals to a depth of 10 feet below fill. Sample recovery was hampered due to the soil matrix. Actual sample intervals are presented in Table 2.1-6.

As a result of Phase I sampling, one additional boring (F131B) was drilled during the Phase II investigation in the summer of 1993. This boring was drilled to groundwater, and was placed near boring F040B. Soil samples were taken at 10-foot intervals below the fill starting at 20 feet. Sample recovery was hampered on many samples due to the soil matrix. The last attempt to collect a soil sample was in the saturated zone at 80 feet with no recovery. No groundwater sample was obtained due to silty conditions, making it impractical to field filter the sample with available equipment. Actual sample intervals are presented in Table 2.1-6. Soil samples were analyzed for the metals, general minerals, and radiological parameters specified in Table 2.1-1, including sulfate and potassium.

PCB Storage Shed. The PCB storage shed was used to store drums of transformer oil with concentrations of PCBs in excess of 50 parts per million (ppm) prior to offsite treatment/disposal. The soils in this area were evaluated by drilling three borings (F043B, F044B, F045B) to a depth of 10 feet below fill. Soil samples were collected below fill (gravel/slag) at the ground surface and at 2.5-foot intervals to a depth of 10 feet below fill. Samples were analyzed for the parameters listed in Table 2.1-1 including PCBs.

Septic Tank Areas. At the FMC plant, septic tanks and drainfields were used for disposal of sanitary sewage. (As of April 4, 1995, all septic wastes are routed to the Pocatello STP). Until 1991, two large drainfields served the main change house. There were also eight drainfields for the main plant. Four borings (F046B, F047B, F048B, F049B) were drilled in the drainfields to evaluate existing soil conditions. Soil samples were collected at the ground surface and at 2.5-foot intervals to a depth of 10 feet below fill. Sample recovery was hampered in boring F046B due to the soil matrix. Only three of the five samples were obtained. Actual sample intervals are presented in Table 2.1-6. Samples were analyzed for the parameters listed in Table 2.1-1 including nitrate.

Calciner Pond Sediment Areas. These areas manage calciner sludge and soil extracted from the former calciner ponds, and treated calciner pond sludge from existing calciner Pond 1C.

Two borings (F050B, F051B) were drilled in these areas to evaluate existing soil conditions. Soil samples were collected at the ground surface and at 2.5-foot intervals to a depth of 10 feet below fill.

Based on the findings of the Phase I investigation, one additional boring (F127B) was drilled for Phase II. This boring was placed near F051B, and was advanced into rock at 38 feet. The boring was sampled at 10-foot intervals starting at the ground surface. Soils were analyzed for the metals, general minerals, and radiological parameters specified in Table 2.1-1, including sulfate and potassium.

Secondary Condenser/Fluid Bed Drier. The fluid bed drier was used in the early 1980s to dry and oxidize precipitator slurry to remove elemental phosphorus. The area is now occupied by the secondary condenser. Soils in this area were evaluated by drilling two borings (F052B, F053B). Soil samples were collected at the ground surface and at 2.5-foot intervals to a depth of 10 feet below fill.

Kiln Scrubber and Overflow Pond. Three kiln scrubber ponds, formerly located under existing calciner 2, and one overflow pond located under the existing calciner fines pile, were used to manage kiln scrubber blowdown in the past. One boring (F054B) was drilled in the vicinity of the former overflow pond so that soils in this area could be evaluated. Soil samples were collected below fill (gravel/slag) at the ground surface and at 2.5-foot intervals to a depth of 10 feet below fill.

Based on the Phase I investigation results, one additional boring (F130B) was drilled for Phase II. This boring was placed near boring F054B, and was advanced to groundwater at 90 feet. The boring was sampled at 10-foot intervals starting at the ground surface below fill. The last soil sample was taken in the saturated zone. Soils were analyzed for the metals, general minerals, and radiological parameters specified in Table 2.1-1, including sulfate and potassium.

Former Pond 7S Tree-Line Area. Former Pond 7S has been removed from service and currently serves as a storage area for ferrophos. Three borings (F055B, F056B, F057B) were drilled in the this area to evaluate existing soil conditions. Soil samples were collected at the ground surface and at a depth of 2 feet below fill (gravel/slag). Samples were analyzed for the parameters indicated in Table 2.1-1 including PCBs.

Borings F056 and F057 were resampled for PCBs during Phase II to validate Phase I results.

8S Recovery Process. The 8S recovery process was built in 1983 to recover elemental phosphorus from Pond 8S; the unit was dismantled in 1993 in accordance with the 8S Closure Plan. Two borings (F058B, F059B) were drilled in this area to evaluate existing soil conditions. Soil samples were collected below fill (gravel/slag) at the ground surface and at a depth of 2 feet below fill. Sample recovery was hampered on boring F059B due to the soil matrix. Actual sample intervals are presented in Table 2.1-6. Samples were analyzed for the parameters indicated in Table 2.1-1 including PCBs and TPH. Borings F060B and F061B were resampled during Phase II to verify Phase I results.

Area West of Mobile Shop. The area west of the mobile shop was used to store and maintain equipment, fuel, motor oil, and lubricants. Samples were collected at two locations (F060B, F061B). Samples from both locations were collected at the ground surface and at a depth of 2 feet below fill. They were analyzed for the parameters listed in Table 2.1-1 including PCBs and TPH.

Long-Term Phosphorus Storage Tanks. FMC uses several tanks to store elemental phosphorus on the south side of a railroad spur west of the furnace building. Soils in this area were evaluated by sampling at two locations (F062B, F063B). Soil samples were collected below the fill (gravel/slag) at the ground surface and at a depth of 2 feet below fill.

Phos Dock Area (Paved). The phos dock area manages elemental phosphorus. Historically, this area has been reported to be the site of spills. Surface samples were collected in one location (F064B). Although a second location (F065B) was planned, it was physically inaccessible.

Paved Area Between Phos Dock and Furnace Building. The elemental phosphorus is loaded into rail cars in the area between the phos dock and the furnace building. Surface samples were collected in four locations (F066B, F067B, F068B, F069B). Soil samples were collected at the soil surface (i.e., below pavement, road base, or slag where they exist) and at a depth of 2 feet below fill.

Phossy Waste Pipeline and Precipitator Slurry Pipeline Cleanouts. Phossy waste is transferred via pipelines to the lined Phase IV ponds. Because of the high solids content and the physical state of the elemental phosphorus, cleanout taps are located along the pipelines at locations where solids may tend to accumulate, such as where the pipelines bend or change direction. Soils in the pipeline cleanout areas were evaluated by sampling at 10 locations (F070B through F079B). Soil samples were collected at the soil surface (i.e., below pavement, road base, or slag where they exist) and at a depth of 2 feet below fill.

Bannock Paving Company Areas. The Bannock Paving Company (BAPCO) leases land from FMC in the north central portion of the FMC property. Slag, coke, and other materials are stored throughout the leased property. Soil samples were collected at five locations (F080B through F084B) throughout the leased property. At each location, samples were collected at the soil surface (i.e., below pavement, road base, or slag where they exist) and at a depth of 2 feet below fill. Samples were analyzed for the parameters listed in Table 2.1-1 including TPH and PCBs.

AEI Property. Materials sent for metals recovery have been stored on the AEI property, located between FMC and I-86, along the western portion of FMC. The activities at this property are poorly documented; however, at one time, the property owner was the subject of fines levied by EPA for violations associated with experimental technologies for metal recovery. Borings 521 and 522 were drilled on FMC property immediately adjacent to the AEI property to investigate potential impacts to soils and to assess this area as a source to groundwater.

Unloading Areas. These areas are used for the unloading of shale ore and coke, and the loading of elemental phosphorus product, crushed ferrophos, and slag. Soil samples were collected at six locations (F083B, F084B, F088B, F089B, F093B, F094B). Borings F089B, F093B, and F094B, located within shale ore handling areas, are discussed below to minimize repetition. At each sample location, samples were collected at the soil surface (i.e., below pavement, road base, or slag where they exist) and at a depth of 2 feet below fill. Samples were analyzed for the parameters listed in Table 2.1-1 including TPH and PCBs. Boring F084B was resampled for PCBs during Phase II to validate Phase I results.

Shale Ore Handling Areas. Ore received at FMC is unloaded into a below-ground hopper and added to an existing stockpile; it is subsequently processed along with silica and coke., Soil samples were collected at six locations (F089B through F094B) at these areas. At each location, samples were collected at the soil surface (i.e., below pavement, road base, or slag where they exist) and at a depth of 2 feet below fill. Samples were analyzed for the parameters listed in Table 2.1-1 including TPH and PCBs. Sample recovery was hampered at boring F089B due to the soil matrix. Actual sample intervals are presented in Table 2.1-6.

Based on the findings of the Phase I investigation, one additional boring, F132B, was drilled for Phase II. This boring was placed near F090B and was advanced to 10 feet below fill. The boring was sampled at 2.5-foot intervals starting at the ground surface. The soil was analyzed for the metals, general minerals, and radiological parameters specified in Table 2.1-1 including sulfate and potassium.

Surface Roads. There are over 15 miles (24 km) of surface roads within the FMC facility property. Soil samples were collected at approximately 20 locations (F101R through F113R, F114R, F115R, F119R through F123R) throughout the facility. At each location, samples were collected at the soil surface (i.e., below pavement or slag where they exist) and at a depth of 2 feet below fill. Samples were analyzed for the parameters listed in Table 2.1-1 including TPH and PCBs.

During Phase I, borings were drilled at several locations along the plant roads to examine the areas where past spills may have occurred, where oils which may have contained PCBs might have been applied for dust control, and to evaluate the leaching which may have occurred from by-products used as fill and applied to the road areas. Based on the Phase I findings, one additional boring (F129B) was drilled during Phase II. This boring was placed near F112R, and was advanced to a depth of 25 feet. The boring was sampled at 2.5-foot intervals starting at the soil surface (i.e., below pavement, road base, or slag where they exist). Soils were analyzed for the metals, general minerals, and radiological parameters specified in Table 2.1-1, including sulfate and potassium. Additional selected locations were resampled for PCBs during Phase II to validate Phase I results; sample identifiers are presented in Table 2.1-6.

2.1.3 SIMPLOT AREAS OF INVESTIGATION

Simplot potential source areas including areas that might have been potential sources in the past, are listed in Table 2.1-7 and shown in Figures 2.1-3 and 2.1-4. These areas have been separated into two groupings: process sources and facility soils. Discussions of these two groupings are presented in the following sections. Table 2.1-7 also provides the sampling rationale, sample depths, number of locations, location references, sample intervals, and analytes for each area.

2.1.3.1 Simplot Process Sources

Phosphate Ore. Phosphate ore, the primary ingredient in the production of phosphoric acid at the Simplot facility, is the material from which trace metals, radionuclides, and other inorganic constituents found in Simplot wastes are originally derived. Consequently, a composite sample of the ore slurry (S3040R1) was collected and dried. The solid portion of the sample was analyzed for the parameters in Table 2.1-1.

Aqueous Discharges. Aqueous streams discharged to units, such as ponds, were sampled and analyzed. These streams are:

- Water discharged to the water treatment ponds (SWWWP101, SWWWP201, SWWWP301, time-composite samples)
- Former east overflow pond water (SWWEOP01, time-composite sample)
- Gypsum slurry discharged to the gypsum stacks (S304GP1, SGSFEF01)

Twenty-four-hour time-composite samples were collected with sample jars from the first two process streams to confirm historical data on the content of these streams. The solid portion of the gypsum slurry sample (S304GP1) was composited over a 1-month period and dried prior to analysis. The liquid portion of the gypsum slurry sample composite (SGSFEF01) was a 24-hour composite that was filtered, and the filtrate was submitted for analysis. Field parameters for the above samples are presented in Table 2.1-8.

A composite sediment/sludge sample was collected with a dredge sampler from each of Simplot's ponds–the former east overflow pond (SSDEOP01) and the three water treatment ponds (SSDWP101, SSDWP201, SSDWP203)–and from the dewatering pit (SSDDWP01).

Irrigation Water. To characterize the Simplot water treatment pond effluent, a location composite sample (SSWIRR01) of the effluent was collected and analyzed for the parameters listed in Table 2.1-2. The sample location is shown in Figure 2.1-4.

2.1.3.2 Simplot Facility Soils

Boring locations are shown in Figure 2.1-3. Unless otherwise noted, samples were analyzed for the parameters listed in Table 2.1-1. Generalized individual sample descriptions and actual sample depths are shown in Table 2.1-9.

Gypsum Stacks. In addition to analysis of the gypsum slurry as described in Section 2.1.3.1, soil beneath the gypsum stacks was characterized. Two borings (S001B, S002B) were drilled through the top of the northernmost (lower) gypsum stack to groundwater at 146 to 136 feet, respectively. Four borings (S003B through S006B) were drilled through the top or north face of the southernmost (upper) gypsum stack to groundwater ranging from 155 to 220 feet. Soil samples were collected at 10-foot intervals beginning at the interface between the gypsum and native soil. Sample recovery was occasionally hampered by the soil matrix. Actual sample intervals are presented in Table 2.1-9.

Settling Pond. The settling pond was at one time approximately twice its current size, occupying its current location and the area immediately to the east. For this reason, boring S007B was drilled to groundwater immediately east of the current pond as a substitute for sampling soils beneath the active pond. Because the water transferred to the settling pond is of essentially the same quality as water transferred to the holding pond, and of poorer quality than water that enters the equalization pond, soil samples collected in this boring should provide a relatively conservative estimate of any release to the soil that may have occurred as a result of leakage from the three ponds. Samples were collected at the surface and at 10-foot intervals thereafter. The last sample, in the saturated zone at 26 feet, was taken from the boring cuttings. This was necessary because no recovery was obtained with the split spoon due to the large amount of gravel at this depth.

Former Unlined Ditch to Water Treatment Ponds. To evaluate existing soil conditions in the former unlined drainage ditch, soil was sampled with a hand auger at six locations along the ditch (SSSUDP01 through SSSUDP06) as indicated in Figure 2.1-4. At each location, samples were collected at the bottom of the ditch and approximately 2 feet below the ditch bottom (SBSUDP01 through SBSUDP06). The samples were analyzed for the parameters indicated in Table 2.1-1. These sample points were subsequently resampled (SSSODP01 through SSSODP06, and SBSODP01 through SBSODP03) for mercury during Phase II.

Based on Phase I findings, one boring (S097B) was drilled during Phase II (between SSSUDP03 and SSSUDP05), and advanced to groundwater at 25 feet. The boring was sampled at 5-foot intervals, starting at the surface, to 25 feet. In addition, a grab groundwater sample was also obtained. Soil and groundwater samples were analyzed for the parameters specified in Tables 2.1-1 and 2.1-10, respectively, including sulfate and potassium.

Dewatering Pit. To evaluate subsurface soils underlying the dewatering pit, soil boring S008B was drilled from the bottom of the pit to groundwater at 26 feet. A soil sample was collected at the interface between pond sludges and native soil and every 10 feet thereafter.

Former Pillow Tank Area. Until 1991, Simplot stored phosphoric acid and UAN-32 (urea and ammonium nitrate) products in thirteen 200,000-gallon pillow, or hypalon, tanks in a series of cells carved out of native soils to a depth of approximately 8 feet. To assess the extent of any releases to the soil, two borings (S010B, S011B) were drilled through the former pillow tank area. Samples were collected at the bottom of the cells to a depth of approximately 10 feet, at intervals of approximately 2.5 feet.

Loadout Areas. The loadout areas fall into three categories: ammonium phosphate loadout area; ammonium sulfate and triple superphosphate loadout areas; and phosphoric acid and sulfuric acid loading areas. Sampling of soils in these areas was conducted to assess the potential impact of constituents resulting from loadout activities and known spills on soils.

Ammonium Phosphate Areas. Soil samples were collected in the truck-loading and railcar-loading areas. Given the absence of any driving force other than natural precipitation for the movement of the solid products and their trace constituents through the soils, samples were only collected immediately below the paved surface and at a depth approximately 2 feet below the interface of pavement and soil during Phase I.

There are two ammonium phosphate loadout areas. Sample borings taken from each location (S030B through S033B and S038 through S041B) are shown in Figure 2.1-3. One proposed boring (S039B) could not be completed because the location was physically inaccessible. Sample recovery was occasionally hampered by the presence of gravel, cobbles, or boulders. Actual sample intervals are presented in Table 2.1-9.

During Phase I, refusal was encountered at 1.5 feet for borings S030B and S031B in the vicinity of the No. 1 ammonium phosphate plant. The materials encountered were composed of fills; to determine the depth of these fill materials and to evaluate impact on subsurface soils, boring S107B was drilled during Phase II near boring S033B. Boring S107B was advanced to 10 feet and soil samples were taken at 2.5-foot intervals starting at the ground surface below the pavement. The soils were analyzed for the metals, general minerals, and radioactivity parameters specified in Table 2.1-1, including sulfate and potassium.

The materials encountered in the vicinity of the No. 2 ammonium phosphate plant during Phase I were also composed of fills. Boring S108B was drilled near boring S044B during Phase II. This boring was advanced to 10 feet and sampled at 2.5-foot intervals starting at the ground surface below pavement. The soils were analyzed for the metals, general minerals, and radiological parameters specified in Table 2.1-1, including sulfate and potassium.

In addition to sampling in the ammonium phosphate loadout areas, samples were collected at four locations along the north sides of each of the ammonium phosphate storage buildings (S034B through S037B and S042B through S045B). Front-end loaders move along the north sides of these buildings carrying reclaim product from the ammonium phosphate production areas, losing some product along the way. These areas are also paved. Samples were collected along the north sides of the two buildings immediately below the pavement and at a depth of approximately 2 feet. Approximate sample locations are shown in Figure 2.1-3. Sample recovery was occasionally hampered by the presence of gravel, cobbles, or boulders. Actual sample intervals are presented in Table 2.1-9.

During Phase I, refusal was encountered in the vicinity of the No. 1 ammonium phosphate plant loading area. The materials encountered were composed of fills; boring S106B was drilled near boring S035B during Phase II. Boring S016B was advanced to 10 feet and soil samples were taken at 2.5-foot intervals starting at the ground surface below the pavement. The soils were analyzed for the metals, general minerals, and radiological parameters specified in Table 2.1-1, including sulfate and potassium.

Ammonium Sulfate and Triple Superphosphate Areas. Soil samples were collected in the truck-loading and railcar-loading areas. Given the absence of any driving force other than natural precipitation for the movement of the solid products and their trace constituents through the soils, samples were only collected immediately below the paved surface and at a depth approximately 2 feet below the interface of pavement and soil. Boring locations for samples collected at the sulfate and triple superphosphate loadout areas (S046B through S049B and S050B through S053B, respectively) are shown in Figure 2.1-3. Sample recovery was occasionally hampered by the presence of gravel, cobbles, or boulders. Actual sample intervals are presented in Table 2.1-9.

The materials encountered during Phase I sampling at the ammonium sulfate plant were composed of fill. To determine the depth of these fill materials and to evaluate subsurface soil conditions, one boring, S109B, was placed near S048B during Phase II. It was advanced to 20 feet below the ground surface. The boring was sampled at 2.5-foot intervals starting at the ground surface. The soils were analyzed for the metals, general minerals, and radiological parameters specified in Table 2.1-1, including sulfate and potassium.

The materials encountered on the south side of the triple superphosphate building (sample borings S050B through S053B) during Phase I were composed of fill. A 10-foot boring (S098B) was subsequently placed near boring S052B during Phase II. The boring was sampled at 2.5-foot intervals starting at the soil surface below the pavement. The soils were analyzed for the metals, general minerals, and radiological parameters specified in Table 2.1-1, including sulfate and potassium.

Phosphoric Acid and Sulfuric Acid Areas. Two of the liquids produced by Simplot are phosphoric acid and sulfuric acid. As with the solid loadout areas, loadout areas for these two liquid products are paved. Borings advanced at the loadout areas are indicated in Figure 2.1-3 (borings S066B and S067B and S058B through S061B, respectively) along with the boring location in the former phosphoric acid loading area, more recently used for railcar-cleaning (S056B, S057B). Proposed boring S057B was not advanced because of physical access restrictions.

Soil sampling in these areas was extended to a depth of 10 feet below fill because of the liquid nature of the materials managed in these areas. Soil samples were collected immediately below any paved surface and at 2.5-foot intervals thereafter. Borings S060B, S061B, S066B, and S067B reached refusal at 5, 8, 4, and 2.5 feet respectively, due to drilling conditions. Actual sample intervals are presented in Table 2.1-9.

Two 10-foot borings (S066B and S067B) were planned in the vicinity of the phosphoric acid loading dock during Phase I. Auger refusal was encountered at 6.5 feet in boring S066B and at 2 feet in S067B; no samples were obtained at these depths. The materials encountered during the drilling were fill. Another boring, S105B, was therefore drilled in the vicinity of boring S067B during Phase II. This boring was advanced to 15 feet, and soil samples were taken at 2.5-foot intervals starting at the surface below the pavement. The soils were analyzed for the metals, general minerals, and radiological parameters specified in Table 2.1-1, including sulfate and potassium.

Auger refusal in the vicinity of the former phosphoric acid railcar-cleaning area also occurred at 2 feet, and only one sample was collected during Phase I. The sample was in a silt and gravel fill. Based on Phase I findings, boring S103 was attempted during Phase II, using a different drilling method. This boring was advanced to 9 feet where refusal was met. Soil samples were taken at 2.5-foot intervals starting at the surface. The soils were analyzed for the metals, general minerals, and radiological parameters specified in Table 2.1-1, including sulfate and potassium.

Former Sulfuric Acid Plants. Soils were sampled at the former No. 1 and No. 2 sulfuric plants (S062B through S065B), as shown in Figure 2.1-3. Using the same rationale provided for borings in the loadout areas, borings were drilled at each of the locations in the former sulfuric plants areas to a depth of 10 feet below fill. At each location, samples were collected at the soil surface and at 2.5-foot intervals thereafter. Borings in this area reached refusal due to drilling conditions before reaching the desired completion depth. Actual sample intervals are presented in Table 2.1-9.

Auger refusal in the vicinity of the former No. 1 sulfuric acid plant was encountered at 8 feet in S063B and at 10 feet in S062B; no samples were obtained at these depths during Phase I. The materials encountered during the drilling were fills. Another boring, S104B, was attempted in the vicinity of boring S062B during Phase II. This boring was advanced to 25 feet and soil sample were taken at 5-foot intervals starting at the surface. The soils were analyzed for the metals, general minerals, and radiological parameters specified in Table 2.1-1, including sulfate and potassium.

Phosphoric Acid Containment. The phosphoric acid containment area receives leakage from phosphoric acid tanks or pipes within the containment; the spilled material flows over the paved surface to a concrete sump, from where it is pumped back to the phosphoric acid reactor or filter. Soil was sampled at two locations (S054B and S055B) in this area. Using the same rationale provided for the phosphoric and sulfuric acid loadout areas, a boring was drilled at both locations to depths of 10 feet. A sample was collected immediately beneath the pavement and at

2.5-foot intervals thereafter. Borings S054B and S055B did not reach their target depth due to drilling conditions or sample refusal at 2.5 and 7 feet, respectively. Actual sample intervals are presented in Table 2.1-9.

Cooling Tower and Former Cooling Pond Area. Saturation of soils occurs in the vicinity of Simplot's cooling towers owing to spray or condensation of reclaim water from the towers. Soils were sampled in the vicinity of the towers and in the area of the former pond at the locations (S068B through S071B) indicated in Figure 2.1-3.

Sample recovery was occasionally hampered by drilling conditions or sample refusal. Boring S069B was the only boring not drilled to its target depth of 10 feet due to gravel refusal at 2 feet. Actual sample intervals are presented in Table 2.1-9.

Auger refusal in the vicinity of the water-cooling tower area was encountered at 9 feet in boring S068B and at 1.5 feet in boring S069B; no samples were obtained at these depths during Phase I. The materials encountered during the drilling were fill. Another boring, S101B, was attempted in the vicinity of boring S069B during Phase II. This boring was advanced to 15 feet and soil samples taken at 2.5-foot intervals starting at the surface. Results of analyses of boring samples S070B and S071B indicate that soils at a depth of 10 feet were still in the zone impacted by facility operations. Therefore, another boring, S100B, was attempted in the vicinity during Phase II. This boring was sampled at 2.5-foot intervals to 15 feet, and at 10-foot intervals to groundwater (which was reached at 75 feet). Additionally, a grab sample of the groundwater encountered was also obtained. The soil and groundwater samples were analyzed for the metals, general minerals, and radiological parameters specified in Tables 2.1-1 and 2.1-10, respectively, including sulfate and potassium.

Water Reclaim Area. Wetting of soils occurs in the water reclaim area as a result of spillage. For this reason, samples were collected at two locations (S072B and S073B) in the water reclaim area. Samples were collected at the soil surface and at a depth of approximately 2.5 feet.

The materials encountered during the drilling were composed of fill. To determine the depth of these materials and to assess subsurface conditions, boring S102B was attempted during Phase II. This boring was placed near boring S073B. It was advanced to 25 feet and sampled at 2.5-foot intervals starting at the ground surface. The soils were analyzed for the metals, general minerals, and radiological parameters specified in Table 2.1-1, including sulfate and potassium.

Former Ore Pile Area. Prior to the completion of Simplot's phosphate ore slurry pipeline, dry phosphate ore was brought to the facility by rail and stockpiled in the former ore pile. To evaluate soil characteristics at this area, surface soil samples were collected at five locations (S074B through S078B) within the area. Given the absence of any driving force other than natural precipitation for the movement of residual phosphate ore and its trace constituents through the soils, samples were only collected at the surface and at a depth of approximately 2 feet.

Salvage and Storage Area. Soil samples were collected at three locations (S079B through S081B) in the salvage and storage area. Samples were collected at the soil surface and at a depth of approximately 2 feet. Collected samples were analyzed for the parameters listed in Table 2.1-1 including TPH and PCBs.

Roads. Soil samples were collected along the roads at approximately 500-linear-foot intervals to assess the potential impact from the application of oils and dust suppressants throughout the facility's history. Most of the roads are paved, although some sections are unpaved and/or covered with gravel/slag. Boring S092B, proposed within the plant, was inaccessible due to the presence of underground utilities. At each sample location (S082B through S096B), samples were collected at the soil surface (i.e., below pavement, gravel, or slag where they exist) and at a depth of approximately 2 feet. The samples were analyzed for the parameters listed in Table 2.1-1 including TPH and PCBs.

Additional selected road sampling locations were resampled for PCBs during Phase II to validate Phase I sampling. Sample identifiers are presented in Table 2.1-9.

Former East Overflow Pond. To investigate the potential impact on soils from the former east overflow pond, boring S099B was placed at the northwest corner of the pond next to the berm during Phase II. This boring was advanced to groundwater at 50 feet. Soil samples were taken at the surface and at 10-foot intervals thereafter. The last soil sample taken was in the saturated zone. A grab groundwater sample was also obtained. The soil and groundwater samples were analyzed for metals, general minerals, and radiological parameters, as specified in Tables 2.1-1 and 2.1-10, plus sulfate and potassium.

Surface and Subsurface Characterizations
Tables for Section 2.1

TABLE 2.1-1
ANALYTICAL PARAMETERS FOR
PHOSPHATE ORE, WASTE, SLUDGE, AND SOIL SAMPLES

I. Heavy Metals	**VI. Volatile Organics[b]**
Aluminum	Chloromethane
Antimony	Bromomethane
Arsenic	Vinyl chloride
Barium	Chloroethane
Beryllium	Methylene chloride
Boron	Acetone
Cadmium	Carbon disulfide
Chromium	1,1-dichloroethene
Cobalt	1,1-dichloroethane
Copper	Trans-1,2-dichloroethene
Iron	Chloroform
Lead	1,2-dichloroethane
Lithium	2-Butanone
Manganese	1,1,1-trichloroethane
Mercury	Carbon tetrachloride
Molybdenum	Vinyl acetate
Nickel	Bromodichloromethane
Selenium	1,2-dichloropropane
Silver	cis-1,3-dichloropropene
Thallium	Trichloroethene
Vanadium	Dibromochloromethane
Zinc	1,1,2-trichloroethane
	Benzene
II. General Mineral	Trans-1,3-dichloropropene
Fluoride	2-chloroethylvinylether
Phosphorus (total)	Bromoform
Phosphorus (orthophosphate)	4-methyl-2-pentanone
Elemental phosphorus (FMC site only)	2-hexanone
	Tetrachloroethene
III. Radioactivity	1,1,2,2-tetrachloroethane
Gross alpha	Tetrahydrofuran
Gross beta	Toluene
Gamma spectroscopy[a]	Chlorobenzene
	Ethylbenzene
IV. Total Petroleum Hydrocarbons (TPH)[b]	Styrene
	Total xylenes
V. Polychlorinated Biphenyls (PCBs)[b]	
Aroclor 1016	**VII. Semivolatile Organics[b]**
Aroclor 1221	Phenol
Aroclor 1232	bis(2-chloro-ethyl)ether
Aroclor 1242	2-chlorophenol
Aroclor 1248	1,3-dichlorobenzene
Aroclor 1254	1,4-dichlorobenzene
Aroclor 1254	benzyl alcohol
	1,2-dichlorobenzene
	2-methylphenol

TABLE 2.1-1 *(continued)*
ANALYTICAL PARAMETERS FOR
PHOSPHATE ORE, WASTE, SLUDGE, AND SOIL SAMPLES

VII. Semivolatile Organics (Continued)	
bis(2-chloroisopropyl)ether	4,6-dinitro-2-methylphenol
4-methylphenol	N-Nitrosodiphenylamine
n-nitroso-dipropylamine	4-Bromophenyl phenyl ether
Hexachloroethane	Hexachlorobenzene
Nitrobenzene	Pentachlorophenol
Isophorone	Phenanthrene
2-nitrophenol	Anthracene
2,3-dimethylphenol	Di-n-butyl phthalate
Benzoic acid	Fluoranthene
bis(2-chloroethoxy)methane	Pyrene
2,4-dichlorophenol	Butyl benzyl phthalate
1,2,4-trichlorobenzene	3,3"-dichlorobenzidine
Naphthalene	Benzo(a)anthracene
4-chloroaniline	bis(2-ethylhexyl)phthalate
Hexachlorobutadiene	Chrysene
4-chloro-3-methylphenol	Di-n-octyl phthalate
2-methylnaphthalene	Benzo(b)fluoranthene
Hexachlorocyclopentadiene	Benzo(k)fluoranthene
2,4,6-trichlorophenol	Benzo(a)pyrene
2,4,5-trichlorophenol	Indeno(1,2,3-c,d)pyrene
2-chloronaphthalene	Dibenzo(a,h)anthracene
2-nitroaniline	Benzo(g,h,l)perylene
Dimethyl phthalate	(1-methylethyl)-Benzene
Acenaphthylene	
3-nitroaniline	
Acenaphthylene	**VIII. Toxicity Characteristics Leaching**
2,4-dinitrophenol	Procedure (TCLP)(c)
4-nitrophenol	
Dibenzofuran	**IX. Other**
2,4-dinitrotoluene	Nitrate(b)
2,6-dinitrotoluene	Potassium(b)
Diethyl phthalate	Sulfate(b)
4-chlorophenyl phenyl ether	pH
Fluorene	
4-nitroaniline	

Notes:

(a) Ore, waste, and sludge samples only.

(b) Select samples. See Tables 2.1-3 and 2.1-7.

(c) Selected samples analyzed for the eight RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) after being subjected to the TCLP extraction procedure. See Table 2.1-3.

TABLE 2.1-2
ANALYTICAL PARAMETERS FOR POTENTIAL SOURCE WATER/WASTE

I. Heavy Metals	II. Water Quality Parameters	III. Radioactivity
Aluminum	Alkalinity (bicarbonate)	Gross Alpha
Antimony	Alkalinity (carbonate)	Gross Beta
Arsenic	Ammonia	Radium-226
Barium	Calcium	Radium-228
Beryllium	Chloride	
Boron	Conductivity	
Cadmium	Fluoride	
Chromium	Magnesium	
Cobalt	Nitrate	
Copper	pH	
Iron	Phosphorus (total)	
Lead	Phosphorus (orthophosphate)	
Lithium	Potassium	
Manganese	Sodium	
Mercury	Sulfate	
Molybdenum	Temperature	
Nickel	Total Dissolved Solids	
Selenium		
Silver		
Thallium		
Vanadium		
Zinc		

TABLE 2.1-3

TABLE 2.1-3
FMC POTENTIAL SOURCE AND FACILITY SOIL INVESTIGATION

Potential Source	Sample ID	Location in Report	Sampling Rationale	Media	Sample Depth	No. of Locations	Sample Intervals	Analytes	Notes
Phase I									
Pond 8S	F020B-F022B	Fig. 2.1-1	Unlined pond, phossy wastes	Soil	to GW	3	SS, 10'	Table 2.1-1	(a)
Old Ponds 1C, 2C	F023B	Fig. 2.1-1	Old ponds-calciner sludge	Soil	to GW	1	SS, 10'	Table 2.1-1	
Pond 4E (dried)	F024B	Fig. 2.1-1	Old ponds-phossy water, ppt. dust	Soil	to GW	1	SS, 10'	Table 2.1-1	
Old Pond 5E	F025B	Fig. 2.1-1	Old ponds-phossy water	Soil	to GW	1	SS, 10'	Table 2.1-1	
Old Pond 6E	F026B	Fig. 2.1-1	Old ponds-phossy water	Soil	to GW	1	SS, 10'	Table 2.1-1	
Landfill, active	F027B	Fig. 2.1-1	Potential solid wastes-AFM	Soil	to GW	1	SS, 10'	Table 2.1-1, Organics	
Chemical Lab Drain Pit	F028B, F029B	Fig. 2.1-1	Drainfield-potential lab chemicals, organics	Soil	to GW	2	SS, 10'	Table 2.1-1, Organics	(b)
IWW Basin/Ditch	F030B	Fig. 2.1-1	Cooling water-potential biocides, corrosion inhibitors	Soil	to GW	1	SS, 10'	Table 2.1-1	
Boiler Fuel Tank and Pipeline Area	B14, B15	Fig. 2.1-1	Potential pipeline leak, spills-TPH	Soil	50 feet	2	5.0'	Table 2.1-1, TPH	
Pond 1E (dried)	F033B	Fig. 2.1-1	Old ponds-phossy water, ppt. dust	Soil	15 feet	1	SS, 5'	Table 2.1-1	(b)
Area 9S	F034B	Fig. 2.1-1	Old ponds-phossy water, ppt. dust	Soil	15 feet	1	SS, 5'	Table 2.1-1	(b)
Transformer Salvage Area	F035B, F036B	Fig. 2.1-1	Potential PCB leaks	Soil	10 feet	2	SS, 2.5'	Table 2.1-1, PCBs	(b)
Waste Oil Storage Area	F037B, F038B	Fig. 2.1-1	Old ponds-phossy water, ppt. dust, PCBs, TPH	Soil	10 feet	2	SS, 2.5'	Table 2.1-1, PCBs, TPH	(b,c)
Railroad Swale	F039B-F042B	Fig. 2.1-1	Potential phos dock spills-phossy water, phosphorus	Soil	10 feet	4	SS, 2.5'	Table 2.1-1	(b,c)
PCB Storage Shed	F043B-F045B	Fig. 2.1-1	Potential PCB spills	Soil	10 feet	3	SS, 2.5'	Table 2.1-1, PCBs	
Septic Tank Areas incl. East of FMC Electric Sign	F046B-F049B	Fig. 2.1-1	Sewage drainfield-nitrate plume	Soil	10 feet	4	SS, 2.5'	Table 2.1-1, Nitrate	
Calciner Pond Sediment Areas South of Calciner Ponds	F050B, F051B	Fig. 2.1-1	Unlined pile-selenium plume, calciner sludge	Soil	10 feet	2	SS, 2.5'	Table 2.1-1	(b)
Secondary Condenser/Fluid Bed Drier Area	F052B, F053B	Fig. 2.1-1	Potential phosphorus spills, leaks	Soil	10 feet	2	SS, 2.5'	Table 2.1-1	
Kiln (Scrubber) Overflow Pond (under calciner fines pile)	F054B	Fig. 2.1-1	Old ponds-selenium, arsenic	Soil	10 feet	1	SS, 2.5'	Table 2.1-1	(d)
Old Pond 7S Tree-Line Area	F055B-F057B	Fig. 2.1-1	Potential PCB spills	Soil	2 feet	3	SS+2'	Table 2.1-1, PCBs	
8S Recovery Process	F058B, F059B	Fig. 2.1-1	Potential spills-arsenic, TPH, PCBs	Soil	2 feet	2	SS+2'	Table 2.1-1, PCBs, TPH	
Area West of Mobile Shop	F060B, F061B	Fig. 2.1-1	Potential oil & lubricant spills-PCBs, TPH	Soil	2 feet	2	SS+2'	Table 2.1-1, PCBs, TPH	
Long-Term Phosphorus Storage Tanks	F062B, F063B	Fig. 2.1-1	Potential phosphorus spills	Soil	2 feet	2	SS+2'	Table 2.1-1	
Phos Dock Area	F064B, F0565B	Fig. 2.1-1	Potential phosphorus spills	Soil	Surface	2	SS	Table 2.1-1	
Paved Area North of Furnace Bldg. incl. Phos Dock	F066B-F069B	Fig. 2.1-1	Potential phosphorus spills	Soil	Surface	4	SS	Table 2.1-1	
Phossy Waste Pipeline Cleanout Areas and Intervals	F070B-F074B	Fig. 2.1-1	Potential spills-arsenic	Soil	2 feet	5	SS+2'	Table 2.1-1	(c)
Precipitator Slurry Pipeline Cleanout Areas and Intervals	F075B-F079B	Fig. 2.1-1	Potential spills-arsenic	Soil	2 feet	5	SS+2'	Table 2.1-1	(b,c)

TABLE 2.1-3

TABLE 2.1-3 *(continued)*
FMC POTENTIAL SOURCE AND FACILITY SOIL INVESTIGATION

Potential Source	Sample ID	Location in Report	Sampling Rationale	Media	Sample Depth	No. of Locations	Sample Intervals	Analytes	Notes
Bannock Paving Areas	F080B-F082B	Fig. 2.1-1	Potential spills, oils, deposition-TPH, PCBs	Soil	2 feet	3	SS+2'	Table 2.1-1, PCBs, TPH	
Railcar Loading & Unloading Areas-BPC	F083B, F084B	Fig. 2.1-1	Potential spills, oils, deposition	Soil	2 feet	2	SS+2'	Table 2.1-1, PCBs, TPH	
Railcar Loading & Unloading Areas-FMC	F085B-F088B	Fig. 2.1-1	Potential spills, oils, deposition	Soil	2 feet	4	SS+2'	Table 2.1-1, PCBs, TPH	
Shale Ore Handling Areas	F089B-F094B	Fig. 2.1-1	Potential deposition	Soil	2 feet	6	SS+2'	Table 2.1-1, PCBs, TPH	
Surface Roads FMC & BPC	F101B-F123B	Fig. 2.1-1	Potential spills, oils, deposition-TPH, PCBs	Soil	2 feet	20	SS+2'	Table 2.1-1, PCBs, TPH	
Water in Railroad Swale	FWWRRS01	Fig. 2.1-2	Potential phosphorus spills	Water	Composite	4	NA	Table 2.1-2	(e)
Water Discharged to Calciner Ponds	FSWCPW01	Fig. 2.1-2	Potential selenium	Water	Composite	1	6 hrs	Table 2.1-2	(f)
IWW Ditch Discharge to Portneuf River	FSWIWW01	Fig. 2.1-2	Cooling water-potential biocides, corrosion inhibitors	Water	Composite	1	6 hrs	Table 2.1-2	(b,f)
Phossy Water Discharged to Phase IV Ponds	FSWPWSTV	Fig. 2.1-2	Phosphorus	Water	Composite	1	6 hrs	Table 2.1-2	(a,f)
Precipitator Slurry Discharged to Pond 8E	FSWPS88E	Fig. 2.1-2	Phosphorus	Slurry	Composite	1	6 hrs	Table 2.1-2	(a,f)
Slag Pile Storage Areas	FWSSSA01 - 06	Fig. 2.1-2	Potential spills, oils, deposition	Soil	Surface	6	NA	Table 2.1-1, TCLP	
Ferrophos Storage Areas	FWSFSA01 - 03	Fig. 2.1-2	Potential spills, oils, deposition	Soil	Surface	3	NA	Table 2.1-1, TCLP	
IWW Ditch Sediments	FSOIWW01 - 06	Fig. 2.1-2	Cooling water-potential biocides, corrosion inhibitors	Soil	Surface	5	NA	Table 2.1-1	(b)
Phosphate Ore	FOSFPO01	Fig. 2.1-2	Potential source of trace elements/radioactivity	Ore		1	NA	Table 2.1-1	
Calciner Pond Sediment Areas	F127B,	Fig. 2.1-2	F050B	Soil	to GW	1	SS, 5'	Table 2.1-1, Sulfate, Potassium	
	F128B	Fig. 2.1-2	F051B	Soil	100 feet	1	SS, 10'	Table 2.1-1, Sulfate, Potassium	
Road Sample	F129B	Fig. 2.1-2	F112R	Soil	25 feet	1	SS, 2.5'	Table 2.1-1, Sulfate, Potassium	
Kiln Scrubber and Overflow Pond	F130B	Fig. 2.1-2	F054B	Soil	to GW	1	0, 10'	Table 2.1-1, Sulfate, Potassium	
Railroad Swale	F131B	Fig. 2.1-2	F040B	Soil	to GW	1	10', 20'	Table 2.1-1, Sulfate, Potassium	
Shale Ore Handling Area	F132B	Fig. 2.1-2	F090B	Soil	10 feet	1	SS, 2.5'	Table 2.1-1, Sulfate, Potassium	
Road Samples	F035B, F056B, F057B, F060B, F061B, F081B, F084B, F101B, F105B, F123B	Fig. 2.1-2	Phase I PCB Validation	Soil	4 feet	10	SS, 2.5'	PCBs	
IWW Ditch Discharge to Portneuf River	0O307IWA thru O307IWQ	Fig. 2.1-2	FSWIWW01	Water	Surface & Subsurface	14	NA	Table 2.1-2	

Notes:
(a) High risk of encountering elemental phosphorus.
(b) Investigated during 1990 drilling program.
(c) Low risk of encountering elemental phosphorus.
(d) Depth is into native soil.
(e) Location-composite sample.
(f) 24-hr composite sample.
GW = Groundwater.
NA = Not applicable.
SS = Surface sample.

TABLE 2.1-4
PHASE I FMC POTENTIAL SOURCE FIELD PARAMETER DATA SUMMARY

Sample ID	Date	Temp (°C)	Specific Conductance ($x10^3$ mS/cm)	pH
FWWRRS01	1 September 92	19.8	1.90	10.16
FSWCPW01	3 September 92	38.0	3.50	4.67
FSWIWW01	3 September 92	25.0	0.130	7.12
FSWPWSIV	3 September 92	23.0	0.375	7.99
FSWPS88E	3 September 92	19.8	1.206	10.47

TABLE 2.1-5
PHASE II IWW DITCH WATER DATA SUMMARY – FIELD PARAMETERS

Days	Sample ID	Date	Time	Location	Est. Flow (gpm)	Avg. Temp	Field Parameters ORP (mv)	pH	Temp (°C)	Conductivity ($x10^3$ mS/cm)	DO (mg/l)	Notes
1	0307IW A[(a)]	8/6/93	07:30	(b)	916	80	120	8.8	22.2	1.351	6.2	
	0307IW B[(a)]	8/6/93	07:30	(b)	916	80	120	8.8	22.2	1.351	6.2	Matrix spike
	0307IW C[(a)]	8/6/93	07:30	(b)	916	80	120	8.8	22.2	1.351	6.2	Matrix spike duplicate
2	0307IW D	7/27/93	07:30	(b)	1712	75	77	8.9	18.5	0.592	6.4	
3	0307IW E[(a)]	7/28/93	07:30	(b)	2036	78	103	8.7	22.1	0.644	6.5	
4	0307IW F[(a)]	7/29/93	07:30	(b)	2002	78	98	8.7	23.3	0.684	6.2	
5	0307IW G[(a)]	7/30/93	07:30	(b)	1964	78	81	8.8	24.2	0.20	6.2	
	0307IW H[(a)]	7/30/93	07:30	(b)	1964	78	81	8.8	24.2	0.20	6.2	Blind duplicate
6	0307IW I	7/31/93	07:30	(b)	1705	77	53	8.9	22.0	0.846	6.1	
7	0307IW J	8/1/93	07:30	(b)	1658	77	72	8.9	21.5	0.786	6.3	
8	0307IW K	8/2/93	07:30	(b)	1688	78	146	9.0	21.6	0.944	6.3	
9	0307IW L	8/3/93	07:30	(b)	1891	79	95	8.8	21.0	0.803	6.1	
10	0307IW M	8/4/93	07:30	(b)	1562	80	111	8.7	21.3	0.848	6.3	
11	0307IW N[(a)]	8/5/93	07:30	(b)	998	80	101	8.5	18.7	0.696	6.2	
12	0307IW O	8/7/93	07:30	(b)	1239	80	114	8.9	19.8	0.984	6.4	
13	0307IW P[(a)]	8/8/93	07:30	(b)	1225	80	101	9.0	19.9	0.712	6.1	
14	0307IW Q	8/9/93	07:30	(b)	1271	81	82	8.9	20.4	0.731	6.2	
	0307IW R1[(a)]	7/25/93	15:00	field trailer	–	–	–	–	–	–		Rinsate

Notes: (a) Samples submitted for analysis.
(b) Location for IWW ditch sampling same as Phase I (September 1992) FSWIWW01.
ORP = oxidation reduction potential

TABLE 2.1-6
FMC POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE I

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
B-12	Sampled at 10-foot intervals	20-95	27-Apr-92	Pond 8S
B-13	Sampled at 10-foot intervals	10-110	28-Apr-92	Pond 8S
150	Sampled at 10-foot intervals	10-100	29-Apr-92	Pond 8S
B-14	Sampled at 5-foot intervals	5-30	14-May-92	Boiler Fuel Tank & Pipeline
B-15	Sampled at 5-foot intervals	5-30	14-May-92	Boiler Fuel Tank & Pipeline
F023B000	Sandy silt, light brown, dry	0	11-Sep-92	Old pond 1C & 2C
F023B010	Clayey silt, strong brown	10	11-Sep-92	Old pond 1C & 2C
F023B020	Clayey silt, strong brown	20	11-Sep-92	Old pond 1C & 2C
F023B030	Clayey silt, strong brown	30	11-Sep-92	Old pond 1C & 2C
F023B040	Sandy gravel, dark yellowish brown	40	11-Sep-92	Old pond 1C & 2C
F023B050	Sandy gravel, dark yellowish brown, angular	50	11-Sep-92	Old pond 1C & 2C
F023B060	Sandy gravel, dark yellowish brown	60	11-Sep-92	Old pond 1C & 2C
F023B070	No recovery	70	11-Sep-92	Old pond 1C & 2C
F024B000	Fill and brown silt	0	16-Sep-92	Pond 4E
F024B010	Silt, brown	10	16-Sep-92	Pond 4E
F024B020	Silt, brown	20	16-Sep-92	Pond 4E
F024B030	Silt, brown	30	16-Sep-92	Pond 4E
F024B040	Silt, brown	40	16-Sep-92	Pond 4E
F024B050	Silt, brown, very moist	50	16-Sep-92	Pond 4E
F024B060	Sandy gravel, brown	60	16-Sep-92	Pond 4E
F024B070	Brown, gravelly sand	70	16-Sep-92	Pond 4E
F024B080	Silt, light yellowish-brown	75	16-Sep-92	Pond 4E
F025B000	Silt, dark olive green - 5 ft.	5	15-Sep-92	Old pond 5E
F025B010	Silt, dark olive green - 5 ft.	10	15-Sep-92	Old pond 5E
F025B020	Silt, light brown	20	15-Sep-92	Old pond 5E
F025B030	Sandy gravel, light brown	30	15-Sep-92	Old pond 5E
F025B040	No recovery	40	15-Sep-92	Old pond 5E
F025B050	No recovery	50	15-Sep-92	Old pond 5E
F025B060	Gravely silt, strong brown	60	15-Sep-92	Old pond 5E
F025B070	Silt, light brown, moist	70	15-Sep-92	Old pond 5E
F026B000	Silt, light yellow-brown - 1.3/1.5 ft.	0	15-Sep-92	Old pond 6E
F026B010	Silt light yellow brown (wet) - 1.35/1.5 ft.	10	15-Sep-92	Old pond 6E
F026B020	No recovery - sandy gravel, grayish brown	20	15-Sep-92	Old pond 6E
F026B030	No recovery - gravel/small boulders	30	15-Sep-92	Old pond 6E

TABLE 2.1-6 *(continued)*
FMC POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE I

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F026B040	No recovery	40	15-Sep-92	Old pond 6E
F026B050	No recovery	50	15-Sep-92	Old pond 6E
F026B060	Silt, brown, wet	60	15-Sep-92	Old pond 6E
F027B000	Light brown silt	0	14-Sep-92	Landfill
F027B010	Silt, brownish-yellow	10	14-Sep-92	Landfill
F027B020	Silt, brownish yellow	20	14-Sep-92	Landfill
F027B030	Silt, brownish yellow	30	14-Sep-92	Landfill
F027B040	Silt, brownish yellow	40	14-Sep-92	Landfill
F027B050	Silt, yellowish-brown	50	14-Sep-92	Landfill
F027B060	Gravelly silt, yellowish-brown	60	14-Sep-92	Landfill
F027B070	Silt, yellowish-brown	70	14-Sep-92	Landfill
F027B080	Silt, yellowish-brown	80	14-Sep-92	Landfill
F027B090	Silt, yellowish-brown	90	14-Sep-92	Landfill
F027B100	Silt, yellowish-brown	100	14-Sep-92	Landfill
F027B110	Silt, yellowish-brown	110	14-Sep-92	Landfill
F027B120	Silt, yellowish-brown	120	14-Sep-92	Landfill
F027B130	Weathered gravel	130	14-Sep-92	Landfill
F027B140	Tuff, light gray	140	14-Sep-92	Landfill
F028B000	Silt/reddish-brown	0	12-Sep-92	N.E. of Chem Lab Seep Pit
F028B010	Silt, reddish-brown	10	12-Sep-92	N.E. of Chem Lab Seep Pit
F028B020	Silt, reddish-brown	20	12-Sep-92	N.E. of Chem Lab Seep Pit
F028B030	Sandy, medium grain (moist)	30	12-Sep-92	N.E. of Chem Lab Seep Pit
F028B040	No recovery	40	12-Sep-92	N.E. of Chem Lab Seep Pit
F028B050	No recovery	50	12-Sep-92	N.E. of Chem Lab Seep Pit
F028B060	No recovery	60	12-Sep-92	N.E. of Chem Lab Seep Pit
F028B070	Clayey silt, brown	70	12-Sep-92	N.E. of Chem Lab Seep Pit
F029B000	Gravelly silt, yellowish-brown	1	12-Sep-92	South of Chem Lab Seep Pit
F029B010	No recovery	10	12-Sep-92	South of Chem Lab Seep Pit
F029B020	Silt, brown	20	12-Sep-92	South of Chem Lab Seep Pit
F029B030	Silt, brown	30	12-Sep-92	South of Chem Lab Seep Pit
F029B040	Sandy gravel, dark yellowish-brown	40	12-Sep-92	South of Chem Lab Seep Pit
F029B050	No recovery	50	12-Sep-92	South of Chem Lab Seep Pit
F029B060	Sand-brown, coarse grain	60	12-Sep-92	South of Chem Lab Seep Pit
F029B070	Silt, brown	70	12-Sep-92	South of Chem Lab Seep Pit
F030B000	Sandy/gravel	0	11-Sep-92	IWW Ditch

TABLE 2.1-6 *(continued)*
FMC POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE I

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F030B010	Brown clayey silt	10	11-Sep-92	IWW Ditch
F030B020	Brown sandy silt (fine grain)	20	11-Sep-92	IWW Ditch
F030B030	Gravel and silty sand, yellowish-brown	30	11-Sep-92	IWW Ditch
F030B040	Gravel and silty sand, yellowish-brown	40	11-Sep-92	IWW Ditch
F030B050	Silty sand, brown, fine grain	50	11-Sep-92	IWW Ditch
F030B065	Silty/sand, dark brown, medium coarse grain	65	11-Sep-92	IWW Ditch
F030B070	Sandy silty gravel, dark brown, moist	75	11-Sep-92	IWW Ditch
F031B	Number not used - skipped sequence	NA	NA	NA
F032B	Number not used - skipped sequence	NA	NA	NA
F033B000	Silt, brownish-yellow	4.5	19-Sep-92	Pond 1E
F033B005	Silt, brownish-yellow	9.5	19-Sep-92	Pond 1E
F033B010	Silt, brownish-yellow	14.5	19-Sep-92	Pond 1E
F033B015	Silt, brownish-yellow	19.5	19-Sep-92	Pond 1E
F034B000	Silt, pale brown	5	19-Sep-92	Area 9S
F034B005	Silt, pale brown	10	19-Sep-92	Area 9S
F034B010	Sandy gravel, reddish-yellow	15	19-Sep-92	Area 9S
F034B015	Sandy gravel, reddish-yellow	20	19-Sep-92	Area 9S
F034R999	Rinsate	NA	18-Sep-92	Area 9S
F035B000	Silt, reddish yellow	2	19-Sep-92	Transformer Salvage Area
F035B002	Silt, reddish yellow	4.5	19-Sep-92	Transformer Salvage Area
F035B005	Silt, reddish brown	7	19-Sep-92	Transformer Salvage Area
F035B007	Silt, reddish brown	9.5	19-Sep-92	Transformer Salvage Area
F035B010	Silt, reddish yellow	12	19-Sep-92	Transformer Salvage Area
F036B000	Silt, light brown	1	19-Sep-92	Transformer Salvage Area
F036B002	Silt, light brown	3.5	19-Sep-92	Transformer Salvage Area
F036B005	Silt, light brown	6	19-Sep-92	Transformer Salvage Area
F036B007	Silt, light brown	8.5	19-Sep-92	Transformer Salvage Area
F036B010	Silt, light brown	11	19-Sep-92	Transformer Salvage Area
F037B000	Silt, whitish-gray	20	19-Sep-92	Waste Oil Storage Area
F037B002	Silt, whitish-gray	22.5	19-Sep-92	Waste Oil Storage Area
F038B	No sampling due to Phos	NA	19-Sep-92	Waste Oil Storage Area
F039B000	Silty gravel, dark yellowish-brown	0	21-Sep-92	Railroad Swale
F039B002	Silt, dark brown	2.5	21-Sep-92	Railroad Swale
F039B005	Sandy gravel, brown	5	21-Sep-92	Railroad Swale
F039B007	Silt, dark grayish-brown	7.5	21-Sep-92	Railroad Swale

TABLE 2.1-6 *(continued)*
FMC POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE I

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F039B010	Silt, dark grayish-brown	10	21-Sep-92	Railroad Swale
F040B000	Silt, yellowish-brown	14	20-Sep-92	Railroad Swale
F040B002	Gravel, coarse sand, brown	16.5	20-Sep-92	Railroad Swale
F040B005	No recovery	19	20-Sep-92	Railroad Swale
F040R999	Rinsate		20-Sep-92	Railroad Swale
F041B000	Dark black, high gravel	7.5	16-Sep-92	Railroad Swale
F041B002	Dark black silt	10	16-Sep-92	Railroad Swale
F041B005	Dark black silt	12.5	16-Sep-92	Railroad Swale
F041B007	No recovery	15	16-Sep-92	Railroad Swale
F041B010	No recovery	17.5	16-Sep-92	Railroad Swale
F041R999	Equipment rinsate from split spoon and sampling trowel	NA	16-Sep-92	Railroad Swale
F042B000	Fill, dark brown	7.5	16-Sep-92	Railroad Swale
F042B002	Silt, brown	10	16-Sep-92	Railroad Swale
F042B005	Silt, brown	12.5	16-Sep-92	Railroad Swale
F042B007	No recovery	15	16-Sep-92	Railroad Swale
F042B010	No recovery	17.5	16-Sep-92	Railroad Swale
F043B000	Dark yellowish brown silt	17	18-Sep-92	PCB Storage Shed
F043B002	Dark yellowish brown silt	19.5	18-Sep-92	PCB Storage Shed
F043B005	Dark yellowish brown silt	22	18-Sep-92	PCB Storage Shed
F043B007	Dark yellowish brown silt	24.5	18-Sep-92	PCB Storage Shed
F043B010	Dark yellowish brown silt	27	18-Sep-92	PCB Storage Shed
F044B000	Dark grayish brown silt (fill)	2	18-Sep-92	PCB Storage Shed
F044B002	Dark grayish brown silt (fill)	4.5	18-Sep-92	PCB Storage Shed
F044B005	Brown silt	7	18-Sep-92	PCB Storage Shed
F044B007	Brown silt	9.5	18-Sep-92	PCB Storage Shed
F044B010	Brown silt	12	18-Sep-92	PCB Storage Shed
F045B000	Yellowish-brown silt (fill)	3	18-Sep-92	PCB Storage Shed
F045B002	Yellowish-brown silt (fill)	5.5	18-Sep-92	PCB Storage Shed
F045B005	Yellowish-brown silt (fill)	8	18-Sep-92	PCB Storage Shed
F045B007	Yellowish-brown silt (fill)	10.5	18-Sep-92	PCB Storage Shed
F045B010	Yellowish-brown silt (fill)	13	18-Sep-92	PCB Storage Shed
F045R999	Rinsate	NA	18-Sep-92	PCB Storage Shed
F046B000	Dark yellowish-brown silt	0	20-Sep-92	Septic Tank Areas
F046B002	Slag gravel (coarse) and mud (black)	2.5	20-Sep-92	Septic Tank Areas
F046B005	Slag gravel	5	20-Sep-92	Septic Tank Areas

TABLE 2.1-6 *(continued)*
FMC POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE I

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F046B007	Silt, dark yellowish-brown	7.5	20-Sep-92	Septic Tank Areas
F046B010	Silt, dark yellowish-brown	10	20-Sep-92	Septic Tank Areas
F047B000	Top soil, dark brown	0	20-Sep-92	Septic Tank Areas
F047B002	Silt, dark yellowish-brown	2.5	20-Sep-92	Septic Tank Areas
F047B005	Silt, dark brown	5	20-Sep-92	Septic Tank Areas
F047B007	Silt, dark brown	7.5	20-Sep-92	Septic Tank Areas
F047B010	Silt, dark brown	10	20-Sep-92	Septic Tank Areas
F048B000	Top soil and silt (yellowish-brown)	0	20-Sep-92	Septic Tank Areas
F048B002	Silt, yellowish-brown	2.5	20-Sep-92	Septic Tank Areas
F048B005	Silt, yellowish-brown	5	20-Sep-92	Septic Tank Areas
F048B007	Silt, yellowish-brown	7.5	20-Sep-92	Septic Tank Areas
F048B010	Silt, yellowish-brown	10	20-Sep-92	Septic Tank Areas
F049B000	Silt, yellowish-brown	1.5	21-Sep-92	Septic Tank Areas
F049B002	Silt, light yellowish-brown	4	21-Sep-92	Septic Tank Areas
F049B005	Silt, light yellowish-brown	6.5	21-Sep-92	Septic Tank Areas
F049B007	Silt, light yellowish-brown	9	21-Sep-92	Septic Tank Areas
F049B010	Silt, light yellowish-brown	11.5	21-Sep-92	Septic Tank Areas
F049R999	Rinsate	NA	21-Sep-92	Septic Tank Areas
F050B000	Red brown clay/silt with sand	0	24-Sep-92	Calciner Pond Sediments
F050B002	Red brown clay/silt with sand - moist	2	24-Sep-92	Calciner Pond Sediments
F050B005	Red brown silt/sand clay - moist	4	24-Sep-92	Calciner Pond Sediments
F050B007	Red brown moist silty clay	6	24-Sep-92	Calciner Pond Sediments
F050B010	Red brown moist silty clay	10	24-Sep-92	Calciner Pond Sediments
F051B000	Red brown silty sand	5	24-Sep-92	Calciner Pond Sediments
F051B002	Red brown to tan silty sand	7	24-Sep-92	Calciner Pond Sediments
F051B005	Red brown to tan silty sand	9	24-Sep-92	Calciner Pond Sediments
F051B007	Red brown silty sand	11	24-Sep-92	Calciner Pond Sediments
F051B010	Red brown silty sand	14	24-Sep-92	Calciner Pond Sediments
F052B000	Brown silt @ 11 ft. - slag on top	10	22-Sep-92	Secondary Condenser
F052B002	Brown silt	12.5	22-Sep-92	Secondary Condenser
F052B005	Brown silt - trace gravel	15	22-Sep-92	Secondary Condenser
F052B007	Brown fine silt - trace gravel (slag) - slightly moist	17.5	22-Sep-92	Secondary Condenser
F052B010	Brown silt - moist	20	22-Sep-92	Secondary Condenser
F053B000	Brown fine silt (moist)	10	22-Sep-92	Secondary Condenser
F053B002	Brown silt with slag	12.5	22-Sep-92	Secondary Condenser

TABLE 2.1-6 *(continued)*
FMC POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE I

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F053B005	Brown fine silt	15	22-Sep-92	Secondary Condenser
F053B007	Brown silt	17.5	22-Sep-92	Secondary Condenser
F053B010	Brown silt	20	22-Sep-92	Secondary Condenser
F054B000	Silt, reddish-yellow	40	20-Sep-92	Under Calciner Fines
F054B002	Silt, reddish-brown	42.5	20-Sep-92	Under Calciner Fines
F054B005	Silt, reddish-yellow	45	20-Sep-92	Under Calciner Fines
F054B007	Silt, reddish-yellow	47.5	20-Sep-92	Under Calciner Fines
F054B010	Silt, reddish-brown	50	20-Sep-92	Under Calciner Fines
F054R999	Rinsate	NA	20-Sep-92	Under Calciner Fines
F055B000	Brown silt	3	23-Sep-92	Old Pond 7S-tree line
F055B002	Brown silt	5	23-Sep-92	Old Pond 7S-tree line
F056B000	Tan brown silt	5	23-Sep-92	Old Pond 7S-tree line
F056B002	Tan silt to black (tar)	7	23-Sep-92	Old Pond 7S-tree line
F057B000	Tan fine silt	5	23-Sep-92	Old Pond 7S-tree line
F057B002	Tan sand/silt with gray clay	7	23-Sep-92	Old Pond 7S-tree line
F058B000	Gravel slag/sludge - black/gray silty/sludge	7	24-Sep-92	8S Recovery Process
F058B002	Black gray sludge to dark brown silt	9	24-Sep-92	8S Recovery Process
F059B000	1st sample 8 in. slag/black gray	10	24-Sep-92	8S Recovery Process
F059B002	Brown sandstone - no recovery	17	24-Sep-92	8S Recovery Process
F060B000	Dark brown silt with gravel	1	25-Sep-92	Area west of mobile shop
F060B002	Dark brown-black sandy silt with gravel	2	25-Sep-92	Area west of mobile shop
F061B000	Dark brown sandy silt with gravel	1	25-Sep-92	Area west of mobile shop
F061B002	Gray black silty sand with gravel	2	25-Sep-92	Area west of mobile shop
F062B000	Tan brown silt	1	26-Sep-92	Long term Phos. Strge
F062B002	Tan brown silt	3	26-Sep-92	Long term Phos. Strge
F063B000	Brown silt (with slag top 1 in.)	5	26-Sep-92	Long term Phos. Strge
F063B002	Brown silt	7	26-Sep-92	Long term Phos. Strge
F063R999	Rinsate	NA	26-Sep-92	Long term Phos. Strge
F064B000	Brown sandy silt with gravel (slag)	2.5	21-Sep-92	Phos Dock Area
F064B002	Brown silt with trace gravel	4.5	21-Sep-92	Phos Dock Area
F065B	No sample, inaccessible due to physical restrictions for access	NA	NA	Phos Dock Area
F066B000	Tan brown silt/sand	3	23-Sep-92	Paved Area N of Fur Bldg
F066B002	Tan brown silt/sand with slag	5	23-Sep-92	Paved Area N of Fur Bldg
F067B000	Tan brown silt with gravel (slag)	5	25-Sep-92	Paved Area N of Fur Bldg

TABLE 2.1-6 *(continued)*
FMC POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE I

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F067B002	Tan brown silt with gravel (slag)	9	25-Sep-92	Paved Area N of Fur Bldg
F068B000	Red brown silt	3	23-Sep-92	Paved Area N of Fur Bldg
F068B002	Tan brown silt	5	23-Sep-92	Paved Area N of Fur Bldg
F069B000	Brown silt	3	23-Sep-92	Paved Area N of Fur Bldg
F069B002	Tan brown fine silt	5	23-Sep-92	Paved Area N of Fur Bldg
F070B000	Brown silt	3	26-Sep-92	Phossy/Slurry Cleanouts
F070B002	Brown tan silt	5	26-Sep-92	Phossy/Slurry Cleanouts
F071B000	Brown silt trace gravel	5	25-Sep-92	Phossy/Slurry Cleanouts
F071B002	Gray gravel/silt 6 in. - brown silt	7	25-Sep-92	Phossy/Slurry Cleanouts
F072B000	Brown silt (wet-pipeline) trace slag -standing water @ 5 ft. bgs	8	25-Sep-92	Phossy/Slurry Cleanouts
F072B002	Brown wet silt	10	25-Sep-92	Phossy/Slurry Cleanouts
F073B002	Slag 2-3 in. to brown silt	14	25-Sep-92	Phossy/Slurry Cleanouts
F073B002	Brown silt	16	25-Sep-92	Phossy/Slurry Cleanouts
F074B000	Gravel/slag fill - tan brown silt with black sand/silt bend in middle @ 2 in. thick	10	25-Sep-92	Phossy/Slurry Cleanouts
F074B002	Brown silt	12	25-Sep-92	Phossy/Slurry Cleanouts
F075B000	Brown silt with trace gravel	5	25-Sep-92	Phossy/Slurry Cleanouts
F075B002	Brown silt	7	25-Sep-92	Phossy/Slurry Cleanouts
F076B000	Brown silt	15	26-Sep-92	Phossy/Slurry Cleanouts
F076B002	Brown silt	17	26-Sep-92	Phossy/Slurry Cleanouts
F077B000	Gravel to 3 ft. - brown sandy silt with gravel	5	26-Sep-92	Phossy/Slurry Cleanouts
F077B002	Gravel fill down to 14 ft. - Brown silt to gravel	14	26-Sep-92	Phossy/Slurry Cleanouts
F078B000	Tan silt interface @ 23-25 ft.	25	26-Sep-92	Phossy/Slurry Cleanouts
F078B002	Brown silt	27	26-Sep-92	Phossy/Slurry Cleanouts
F079B000	Red brown clayey silt	5	23-Sep-92	Phossy/Slurry Cleanouts
F079B002	Red brown silt	7	23-Sep-92	Phossy/Slurry Cleanouts
F080B000	Tan-brown silt	5	24-Sep-92	Bannock Paving
F080B002	Tan-brown silt	7	24-Sep-92	Bannock Paving
F081B000	Tan-brown silt (moist)	4	24-Sep-92	Bannock Paving
F081B002	Tan-brown silt	7	24-Sep-92	Bannock Paving
F082B000	Tan-brown sandy silt	5	24-Sep-92	Bannock Paving
F082B002	Brown silt with sand	9	24-Sep-92	Bannock Paving
F083B000	Brown tan silt	5	24-Sep-92	RR loading BPC
F083B002	Brown silt	9	24-Sep-92	RR loading BPC

TABLE 2.1-6 *(continued)*
FMC POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE I

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F084B000	Tan-brown silt with gravel (slag)	5	24-Sep-92	RR loading BPC
F084B002	Brown silt	7	24-Sep-92	RR loading BPC
F085B	No sample, inaccessible due to underground utilities	NA	NA	RR loading FMC
F086B	No Sample-Duplicate boring of F093B	Dup	Dup	RR loading FMC
F087B	No Sample-Duplicate boring of F094B	Dup	Dup	RR loading FMC
F089B000	Gravel fill and tan silt	Dup	Dup	RR loading FMC
F089B002	No sample	5	23-Sep-92	Shale Ore Handling
F090B000	Dark brown silt with trace gravel	3	21-Sep-92	Shale Ore Handling
F090B002	Dark brown silt	5	21-Sep-92	Shale Ore Handling
F091B000	Tan-red-brown silt with gravel	0	21-Sep-92	Shale Ore Handling
F091B002	Brown silt with gravel	2	21-Sep-92	Shale Ore Handling
F092B000	Red-brown to black-gray to light tan silty sand with gravel	0	21-Sep-92	Shale Ore Handling
F092B002	Brown silt with gravel	2	21-Sep-92	Shale Ore Handling
F093B000	Brown-red brown silt (shale)	3	22-Sep-92	Shale Ore Handling
F093B002	Red-brown silt	5	22-Sep-92	Shale Ore Handling
F094B000	Dark brown to tan silt/sand	6	23-Sep-92	Shale Ore Handling
F094B002	Dark brown silt	8	23-Sep-92	Shale Ore Handling
F095B	Number not used, skipped sequence	NA	NA	NA
F096B	Number not used, skipped sequence	NA	NA	NA
F097B	Number not used, skipped sequence	NA	NA	NA
F098B	Number not used, skipped sequence	NA	NA	NA
F099B	Number not used, skipped sequence	NA	NA	NA
F100B	Number not used, skipped sequence	NA	NA	NA
F101B000	Brown silt with slag gravel	5	22-Sep-92	Road Sample
F101B002	Brown silt	7	22-Sep-92	Road Sample
F101R000	Dark brown silty sand trace gravel	0.5	26-Sep-92	Road Sample-Redo
F101R002	Gray sandy silt w/trace gravel	1.5	26-Sep-92	Road Sample-Redo
F102B000	Tan-brown silt	3	24-Sep-92	Road Sample
F102B002	Tan-brown moist silt	5	24-Sep-92	Road Sample
F103B000	Tan-brown silt	3	24-Sep-92	Road Sample
F103B002	Tan-brown silt	5	24-Sep-92	Road Sample
F104R000	Gray slag	0.5	26-Sep-92	Road Sample
F104R002	Gray slag	1.5	26-Sep-92	Road Sample
F105B000	Dark grayish brown silt (fill)	1	18-Sep-92	Road Sample

TABLE 2.1-6 *(continued)*
FMC POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE I

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F105B002	Dark grayish brown silt (fill)	3	18-Sep-92	Road Sample
F106B000	Tan brown silt	1	24-Sep-92	Road Sample
F106B002	Tan silt	3	24-Sep-92	Road Sample
F107R000	Slag gravel	0.5	26-Sep-92	Road Sample
F107R002	Slag/gravel/brown silt - Contact @ 2.7 to 3 ft	1.5	26-Sep-92	Road Sample
F108B000	Tan silt with gravel	0.5	21-Sep-92	Road Sample
F108B002	Dark tan silt	2.5	21-Sep-92	Road Sample
F109B000	Road surface gypsum/slag/gravel @ 1/2 ft. - Tan brown silt trace gravel	0.5	21-Sep-92	Road Sample
F109B002	Tan silt	2.5	21-Sep-92	Road Sample
F110B000	Dark brown/black silt with gravel	0.5	21-Sep-92	Road Sample
F110B002	Brown to dark brown/black silt with trace gravel	2.5	21-Sep-92	Road Sample
F111R000	Gray silt with slag (gravel) (gravel @ 10%)	0.5	26-Sep-92	Road Sample
F111R002	Gray silt with slag (gravel)	2	26-Sep-92	Road Sample
F112R000	Gray silt with slag (slag coarse/fine @ 20%)	0.5	26-Sep-92	Road Sample
F112R002	Gray silt with trace slag (fine < 10%)	2	26-Sep-92	Road Sample
F113R000	Dark brown/gray sand silt trace gravel	0.5	26-Sep-92	Road Sample
F113R002	Tan brown sandy silt	2	26-Sep-92	Road Sample
F113R999	Rinsate	NA	29-Sep-92	Road Sample
F113R9MS	Rinsate	NA	29-Sep-92	Road Sample
F113RMSD	Rinsate	NA	29-Sep-92	Road Sample
F114R000	Dark brown/gray silt/sand (heavy) trace gravel slag	0.5	26-Sep-92	Road Sample
F114R002	Brown sandy silt	2	26-Sep-92	Road Sample
F115R000	Dark brown sandy silt	0.5	26-Sep-92	Road Sample
F115R002	Tan-brown silt	2	26-Sep-92	Road Sample
F116B	No sample, inaccessible due to plant operations & utilities	NA	NA	Road Sample
F117B	No sample, inaccessible due to plant operations & utilities	NA	NA	Road Sample
F118B	No sample, inaccessible due to plant operations & utilities	NA	NA	Road Sample
F119R000	Red brown fine silt (shale ore)	0.5	26-Sep-92	Road Sample
F119R002	Dark red brown silt (shale ore)	2	26-Sep-92	Road Sample
F120B	No sample-duplicate boring		Dup	Road Sample
F121R000	Gray silt/slag (heavy fine) - Rock 2-8 in. in size below surface	0.5	26-Sep-92	Road Sample
F121R002	Gray silt (slag) with gravel (coarse @ 30%)	2	26-Sep-92	Road Sample

TABLE 2.1-6 *(continued)*
FMC POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE I

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F122B000	Clean fill - brown silt	0	25-Sep-92	Road Sample
F122B002	Clean fill - brown silt	2	25-Sep-92	Road Sample
F123B000	Brown sandy silt trace gravel (on haul road dusty trucks passing)	2	24-Sep-92	Road Sample
F123B002	Brown silt	4	24-Sep-92	Road Sample
F124B000	Slag/gravel - slag 0-5 ft.	10	26-Sep-92	Road Sample
F124B002	Tan-brown silt/sandstone	12	26-Sep-92	Road Sample
F125B000	Tan fine silt	1	26-Sep-92	Road Sample
F125B002	Brown silt	3	26-Sep-92	Road Sample
F126B000	Tan silt with gravel	0	30-Sep-92	Road Sample
F126B002	Tan silt with gravel	2	30-Sep-92	Road Sample
F200R999	Rinsate	NA	21-Sep-92	Road Sample

TABLE 2.1-6 *(continued)*
FMC POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE II

Phase II Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F127B000	Sludge	0	23-Jun-93	Calciner Pond Sediments
F127B005	Tan silt	5	23-Jun-93	Calciner Pond Sediments
F127B015	Tan silt	15	23-Jun-93	Calciner Pond Sediments
F127B025	Tan silt	25	23-Jun-93	Calciner Pond Sediments
F127B035	Tan silt (wet)	35	23-Jun-93	Calciner Pond Sediments
F127R999	Rinsate	NA	23-Jun-93	@ Calciner Pond Sediments
F128B000	Tan silt with gravel	0	22-Jun-93	Calciner Pond Sediments
F128B010	Tan silt	10	22-Jun-93	Calciner Pond Sediments
F128B020	Tan silt	20	22-Jun-93	Calciner Pond Sediments
F128B030	Tan silty sandy gravel	30	22-Jun-93	Calciner Pond Sediments
F128B040	Tan silt	40	22-Jun-93	Calciner Pond Sediments
F128B050	Gravel	50	22-Jun-93	Calciner Pond Sediments
F128B060	Sandy gravel	60	22-Jun-93	Calciner Pond Sediments
F128B070	Sandy gravel	70	22-Jun-93	Calciner Pond Sediments
F128B080	Sandy gravel	80	22-Jun-93	Calciner Pond Sediments
F128B090	No recovery @ 90 feet (no sample)	NA	22-Jun-93	Calciner Pond Sediments
F128B100	Tan silt with gravel	100	22-Jun-93	Calciner Pond Sediments
F129B000	Gravel (fill)	0	27-Jun-93	Furnace Haul Road
F129B005	Tan silt	5	27-Jun-93	Furnace Haul Road
F129B010	Tan silt	10	27-Jun-93	Furnace Haul Road
F129B015	Tan silt	15	27-Jun-93	Furnace Haul Road
F129B020	Tan silt	20	27-Jun-93	Furnace Haul Road
F129B025	Tan silt	25	27-Jun-93	Furnace Haul Road
F130B000	Tan silty sand	0	27-Jun-93	Calciner fines pile (F054B)
F130B010	Tan silt	10	27-Jun-93	Calciner fines pile (F054B)
F130B020	Tan silt	20	27-Jun-93	Calciner fines pile (F054B)
F130B030	Sandy gravel	30	27-Jun-93	Calciner fines pile (F054B)
F130B040	Sandy gravel	40	27-Jun-93	Calciner fines pile (F054B)
F130B050	Sandy gravel	50	27-Jun-93	Calciner fines pile (F054B)
F130B060	Sandy gravel	60	27-Jun-93	Calciner fines pile (F054B)
F130B070	Sandy silt	70	27-Jun-93	Calciner fines pile (F054B)
F130B080	Gravel	80	27-Jun-93	Calciner fines pile (F054B)
F130B090	Sandy gravel	90	27-Jun-93	Calciner fines pile (F054B)
F131B000	No recovery	NA	28-Jun-93	RR Swale
F131B010	No recovery	NA	28-Jun-93	RR Swale

TABLE 2.1-6 *(continued)*
FMC POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE II

Phase II Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F131B020	Gravel	NA	28-Jun-93	RR Swale
F131B030	Sandy gravel	NA	28-Jun-93	RR Swale
F131B040	Sand	40	28-Jun-93	RR Swale
F131B050	Gravel	NA	28-Jun-93	RR Swale
F131B060	Tan silty clay	60	28-Jun-93	RR Swale
F131B070	Brown clay	70	28-Jun-93	RR Swale
F131B080	Sandy gravel	80	28-Jun-93	RR Swale
F131R999	Rinsate	NA	28-Jun-93	@ RR Swale
F132B000	Gravelly silt	0	25-Jul-93	Shale Handling Area
F132B002	Gravelly silt	2	25-Jul-93	Shale Handling Area
F132B005	Tan silt	5	25-Jul-93	Shale Handling Area
F132B007	Tan silt	7	25-Jul-93	Shale Handling Area
F132B010	Tan silt	10	25-Jul-93	Shale Handling Area
F132B012	Tan silt	12	25-Jul-93	Shale Handling Area
F132R999	Rinsate	NA	26-Jul-93	@ Shale Handling Area
	Soil samples from well installations			
F158B093	Brown sandy silt	93	23-Jun-93	Well upgradient of 8S
F159B096	Tan silty clay	96	26-Jun-93	Well downgradient of 8S
	PCB resampling locations			
F035B000	Tan silt	2	6-Aug-93	Transformer Salvage Area
F056B002	Brown silt	5	6-Aug-93	Old Pond 7S-tree line
F057B000	Tan silt	5	6-Aug-93	Old Pond 7S-tree line
F057B002	Tan silt	7	6-Aug-93	Old Pond 7S-tree line
F060B000	Brown silt with gravel	1	6-Aug-93	Area west of mobile shop
F060B002	Brown silt with gravel	2	6-Aug-93	Area west of mobile shop
F061B000	Brown sandy silt	1	6-Aug-93	Area west of mobile shop
F061B002	Gray/brown sandy silt	2	6-Aug-93	Area west of mobile shop
F081B000	Tan silt	4	6-Aug-93	Bannock Paving
F084B000	Brown silt	5	6-Aug-93	RR loading BPC
F084B002	Brown silt	7	6-Aug-93	RR loading BPC
F101B000	Tan silt	5	6-Aug-93	Road Sample
F105B000	Tan silt	1	6-Aug-93	Road Sample
F123B000	Tan silt	2	6-Aug-93	Road Sample

TABLE 2.1-6 *(continued)*
FMC POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE II

Phase II Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F123B002	Brown silt	4	6-Aug-93	Road Sample
F060R999	Rinsate	NA	6-Aug-93	@ boring F060B

Notes: NA = Not applicable.

TABLE 2.1-7
SIMPLOT POTENTIAL SOURCE AND FACILITY SOIL INVESTIGATION

Potential Source	Sample ID	Location in Report	Sampling Rationale	Media	Sample Depth	No. of Locations	Sample Intervals	Analytes
Phase I								
Ore Slurry	S304OR1	Fig. 2.1-4	Trace elements	Slurry	Composite-Time	1	NA	Table 2.1-1
Gypsum Slurry	S304GP1, SGSFEF01	Fig. 2.1-4	Trace elements	Slurry	Composite-Time	1	NA	Table 2.1-1
Pond Waters	SWW9101, SWWWP201, SWWWP301, SWWE0P01	Fig. 2.1-4	Trace elements		Composite-Time	4	NA	Table 2.1-2
Pond Sediments	SSDWP101, SSDWP201, SSDWP301, SSDE0P01	Fig. 2.1-4	Trace elements		Composite-Location	4	NA	Table 2.1-1
Gypsum Stacks	S001B thru S006B	Fig. 2.1-3	Gypsum water migration	Soils	to GW	6	10'	Table 2.1-1
Unlined Ditch to Water Treatment Ponds	SSSUDP01 thru SSSUDP06, SBSJDP01 thru SBSJDP06	Fig. 2.1-4	Ditch water migration	Soils	2 feet	6	SS+2'	Table 2.1-1
Former East Overflow Pond	S099B	Fig. 2.1-3	Pond water migration	Soils	to GW	1	10'	Table 2.1-1
Water Treatment Ponds:								
Settling Pond (Active)	S007B	Fig. 2.1-3	Potential pond water migration	Soils	to GW	1	10'	Table 2.1-1
Dewatering Pit	S008B	Fig. 2.1-3	Pit water migration	Soils	to GW	1	10'	Table 2.1-1
Former Pillow Tank Area	S010B - S011B	Fig. 2.1-3	Potential tank leakage	Soils	10 feet	2	2.5'	Table 2.1-1
Loadout Areas (soils):		Fig. 2.1-3	Potential product spillage	Soils				
Ammonium Phosphate #1 (solid)								
Rail	S030B, S031B				2 feet	2	SS+2'	Table 2.1-1
Truck and Front-End Loader	S032B, S037B				2 feet	6	SS+2'	Table 2.1-1
Ammonium Phosphate #2 (solid)								
Rail	S038B, S039B				2 feet	2	SS+2'	Table 2.1-1
Truck and Front-End Loader	S040B, S045B				2 feet	6	SS+2'	Table 2.1-1
Ammonium Sulfate (solid)								
Rail	S046B, S047B				2 feet	2	SS+2'	Table 2.1-1
Truck	S048B, S049B				2 feet	2	SS+2'	Table 2.1-1
Triple Superphosphate (solid)								
Rail	S050B, S051B				2 feet	2	SS+2'	Table 2.1-1
Truck	S052B, S053B				2 feet	2	SS+2'	Table 2.1-1
Phosphoric Acid (liquid)								
Truck	S066B, S067B				10 feet	2	2.5'	Table 2.1-1
Former Phosphoric Acid (liquid)/Rail Car Cleaning								
Rail	S056B, S057B				10 feet	2	2.5'	Table 2.1-1
Sulfuric Acid (liquid)								
Rail	S058B, S059B				10 feet	2	2.5'	Table 2.1-1
Truck	S060B, S061B				10 feet	2	2.5"	Table 2.1-1

TABLE 2.1-7 (continued)
SIMPLOT POTENTIAL SOURCE AND FACILITY SOIL INVESTIGATION

Potential Source	Sample ID	Location in Report	Sampling Rationale	Media	Sample Depth	No. of Locations	Sample Intervals	Analytes
Former #1 Sulfuric Plant	S001B-062, S001B-063	Fig. 2.1-3	Potential plant leakage	Soils	10 feet	2	2.5'	Table 2.1-1
Former #2 Sulfuric Plant	S001B-064, S001B-065	Fig. 2.1-3	Potential plant leakage	Soils	10 feet	2	2.5'	Table 2.1-1
Phosphoric Acid Tank Containment	S001B-054, S001B-055	Fig. 2.1-3	Potential tank leakage	Soils	10 feet	2	2.5'	Table 2.1-1
Cooling Tower Area	S001B-068, S001B-069	Fig. 2.1-3	Cooling tower spray	Soils	10 feet	2	2.5'	Table 2.1-1
Former Cooling Pond	S001B-070, S001B-071	Fig. 2.1-3	Pond water migration	Soils	10 feet	2	2.5'	Table 2.1-1
Water Reclaim Area	S001B-072, S001B-073	Fig. 2.1-3	Potential pipe/pump leakage	Soils	2 feet	2	SS+2'	Table 2.1-1
Former Ore Pile Area	S001B-074 thru S001B-078	Fig. 2.1-3	Residual ore	Soils	2 feet	5	SS+2'	Table 2.1-1
Salvage and Storage Area	S001B-079 thru S001B-081	Fig. 2.1-3	Answer persistent questions	Soils	2 feet	3	SS+2'	Table 2.1-1, PCBs, TPH
Roads (paved, unpaved, slag covered)	S001B-082 thru S001B-096	Not Shown	Dust suppressant application	Soils	2 feet	15	SS+2'	Table 2.1-1, PCBs, TPH
Phase II								
Irrigation Water		Not Shown	Trace elements		Composite	1	NA	Table 2.1-2
Unlined Ditch	S097B	Fig. 2.1-3	Phase I Sampling	Soils	to GW	1	SS, 5'	Table 2.1-1, sulfate, potassium
Triple Superphosphate Area	S098B	Fig. 2.1-3	S052B	Soils	10 feet	1	SS, 2.5'	Table 2.1-1, sulfate, potassium
Former East Overflow Pond	S099B	Fig. 2.1-3	Pond water migration	Soils	50 feet	1	SS, 10'	Table 2.1-1, sulfate, potassium
Cooling Pond	S100B	Fig. 2.1-3	S070B and S071B	Soils	to GW	1	SS, 2.5 - 10'	Table 2.1-1, sulfate, potassium
Cooling Tower	S101B	Fig. 2.1-3	S069B	Soils	15 feet	1	SS, 1.5'	Table 2.1-1, sulfate, potassium
Water Reclaim Area	S102B	Fig. 2.1-3	S073B	Soils	25 feet	1	SS, 2.5'	Table 2.1-1, sulfate, potassium
Railcar Cleaning	S103B	Fig. 2.1-3	S056B	Soils	9 feet	1	SS, 2.5'	Table 2.1-1, sulfate, potassium
Former #1 Sulfuric Plant	S104B	Fig. 2.1-3	S062B	Soils	25 feet	1	SS, 5'	Table 2.1-1, sulfate, potassium
Phos Acid Loading	S105B	Fig. 2.1-3	S067B	Soils	15 feet	1	SS, 2.5'	Table 2.1-1, sulfate, potassium
Ammonium Phosphate #1	S106B	Fig. 2.1-3	S035B	Soils	10 feet	1	SS, 2.5'	Table 2.1-1, sulfate, potassium
Ammonium Phosphate #1	S107B	Fig. 2.1-3	S033B	Soils	10 feet	1	SS, 2.5'	Table 2.1-1, sulfate, potassium
Ammonium Phosphate #2	S108B	Fig. 2.1-3	S044 B	Soils	10 feet	1	SS, 2.5'	Table 2.1-1, sulfate, potassium
Ammonium Sulfate	S109B	Fig. 2.1-3	S048B	Soils	20 feet	1	SS, 2.5 and 5'	Table 2.1-1, sulfate, potassium
Road Samples	S063B, S079B, S080B, S085B, S088B, S090B, S094B, S098B	Fig. 2.1-3	Phase I PCB Validation	Soils	Surface	8	SS	PCB
Unlined Ditch	SSSODP01 thru SSSODP06, SBSODP01 thru SBSODP03	Fig. 2.1-3	Phase I Sampling	Soils	2 feet	9	SS, 2'	Hg

Notes: GW = Groundwater.
NA = Not applicable.
SS = Surface sample.

TABLE 2.1-8
SIMPLOT POTENTIAL SOURCE FIELD DATA (AVERAGED READINGS)

Sample ID	Date	pH	Conductivity (x10^3 mS/cm)	Temperature (deg F)
SWWWP101[a]	31 August 92	1.0	3035	77
SWWWP201[a]	31 August 92	7.6	860	69
SWWWP301[a]	31 August 92	8.3	2625	72
SWWEOP01[a]	31 August 92	1.0	9500	70
SSWIRR01[b]	28 October 92	7.5	3840	64

Notes: (a) Denotes 24-hour time-composite sample.
(b) Location-composite sample.

TABLE 2.1-9
SIMPLOT POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE I

Phase I Sample IDs	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S001B000	Silt, very dark grayish-brown	65	9/27/92	North Gyp to GW
S001B010	Silt, yellowish-brown	75	9/27/92	North Gyp to GW
S001B020	Sandy-gravel, light brown-gray	85	9/27/92	North Gyp to GW
S001B030	Sandy-gravel, light grayish brown	95	9/27/92	North Gyp to GW
S001B040	Sandy-gravel, light grayish brown	105	9/27/92	North Gyp to GW
S001B050	Silt, pale brown	115	9/27/92	North Gyp to GW
S001B060	Silt, pale brown	125	9/27/92	North Gyp to GW
S001B070	Sandy gravel, yellowish brown	135	9/27/92	North Gyp to GW
S001B080	Dark gray-brown, sandy pea gravel	145	9/27/92	North Gyp to GW
S001R999	Rinsate	NA	9/27/92	North Gyp to GW
S002B000	Silt, dark brown	65	9/23/92	North Gyp to GW
S002B010	Dark brown silt	75	9/23/92	North Gyp to GW
S002B020	Silt/gravel, pinkish-gray	85	9/23/92	North Gyp to GW
S002B030	Silty-gravel, pinkish-gray	95	9/23/92	North Gyp to GW
S002B040	Silty gravel, pinkish-gray	105	9/23/92	North Gyp to GW
S002B050	Silt, yellowish-brown	115	9/23/92	North Gyp to GW
S002B060	Sandy gravel, yellowish brown	125	9/23/92	North Gyp to GW
S002B070	Silt, brownish-yellow	135	9/23/92	North Gyp to GW
S003B000	Silty pea gravel-pale brown	61	10/9/92	South Gyp to GW
S003B010	Silt, brownish yellow (moist)	70	10/9/92	South Gyp to GW
S003B020	Silt, brownish yellow	80	10/9/92	South Gyp to GW
S003B030	Silt, brown	90	10/9/92	South Gyp to GW
S003B040	Silty gravel	100	10/9/92	South Gyp to GW
S003B050	Silty sand, brown	115	10/9/92	South Gyp to GW
S003B060	Clayey sand, gray and brownish orange	135	10/9/92	South Gyp to GW
S003B070	Clayey sand, gray and brownish orange	145	10/9/92	South Gyp to GW
S003B080	Sand with gravel	155	10/9/92	South Gyp to GW
S003R999	Rinsate	NA	10/11/92	South Gyp to GW
S003	Rinsate	NA	10/13/92	South Gyp to GW
S03AR999	Rinsate	NA	10/13/92	South Gyp to GW
S03AR9MS	Rinsate	NA	10/13/92	South Gyp to GW
S03ARMSD	Rinsate	NA	10/13/92	South Gyp to GW
S004B000	Silt, pale brown	53	10/1/92	South Gyp to GW
S004B010	Silt, pale brown	60	10/1/92	South Gyp to GW
S004B020	Silt, pale brown	70	10/1/92	South Gyp to GW

TABLE 2.1-9 *(continued)*
SIMPLOT POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE I

Phase I Sample IDs	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S004B030	Silt, light brown	80	10/1/92	South Gyp to GW
S004B040	Silt, light brown	90	10/1/92	South Gyp to GW
S004B050	Silt, light brown	100	10/1/92	South Gyp to GW
S004B060	Silt, light brown (small bits pea gravel)	110	10/1/92	South Gyp to GW
S004B070	Tuff, light gray	120	10/1/92	South Gyp to GW
S004B080	Silty sand, very pale brown	130	10/1/92	South Gyp to GW
S004B090	Silty-sand, light brown	140	10/1/92	South Gyp to GW
S004B100	Light gray clay	150	10/1/92	South Gyp to GW
S004B110	Light brown silt and clay	160	10/1/92	South Gyp to GW
S005B000	Silt, yellowish brown	40	10/14/92	South Gyp to GW
S005B010	Silt, yellowish brown	50	10/14/92	South Gyp to GW
S005B020	Silt, yellowish brown	60	10/14/92	South Gyp to GW
S005B030	Silt, yellowish brown	70	10/14/92	South Gyp to GW
S005B040	Silt, yellowish brown	80	10/14/92	South Gyp to GW
S005B050	Silt, yellowish brown	90	10/14/92	South Gyp to GW
S005B060	Silt, yellowish brown	100	10/14/92	South Gyp to GW
S005B070	Silt, yellowish brown (@ 10% gravel)	110	10/14/92	South Gyp to GW
S005B080	Silt, yellowish brown	120	10/14/92	South Gyp to GW
S005B090	Silt, yellowish brown	130	10/14/92	South Gyp to GW
S005B100	Sandy silt, moderate yellowish brown	140	10/14/92	South Gyp to GW
S005B110	Sandy silt, moderate yellowish brown	150	10/14/92	South Gyp to GW
S005B120	Sandy silt, moderate yellowish brown	160	10/14/92	South Gyp to GW
S005B130	Sandy silt, moderate yellowish brown	170	10/14/92	South Gyp to GW
S005B140	Sandy silt, moderate yellowish brown	180	10/14/92	South Gyp to GW
S005B150	Sandy silt, moderate yellowish brown	190	10/14/92	South Gyp to GW
S005B160	Sandy silt, moderate yellowish brown	200	10/14/92	South Gyp to GW
S005B170	Silty sand, pale yellowish brown	210	10/14/92	South Gyp to GW
S005B180	Silty sand, pale yellowish brown	220	10/14/92	South Gyp to GW
S006B000	Sandy, gravelly silt	44.6	10/21/92	South Gyp to GW
S006B010	Silty, sandy gravel	55	10/21/92	South Gyp to GW
S006B020	Silty, sandy gravel	65	10/21/92	South Gyp to GW
S006B030	Brown/tan silt	70	10/21/92	South Gyp to GW
S006B040	Yellowish brown silty/sandy/gravel	85	10/21/92	South Gyp to GW
S006B050	Yellowish brown silty/sandy/gravel	95	10/21/92	South Gyp to GW
S006B060	Yellowish brown silty/sandy/gravel	105	10/21/92	South Gyp to GW

TABLE 2.1-9 *(continued)*
SIMPLOT POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE I

Phase I Sample IDs	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S006B070	Yellowish brown silt embedded in gravel (silty/sandy/gravel)	115	10/21/92	South Gyp to GW
S006B080	Yellowish brown silty/sandy/gravel	125	10/21/92	South Gyp to GW
S006B090	Yellowish brown silty/sandy/gravel	135	10/21/92	South Gyp to GW
S006B100	Yellowish brown silty/sandy/gravel	145	10/21/92	South Gyp to GW
S006B110	Yellowish brown silty/sandy/gravel	155	10/21/92	South Gyp to GW
S006B120	Red sand, coarse-grained	165	10/21/92	South Gyp to GW
S006B130	Red sand, coarse-grained	169	10/21/92	South Gyp to GW
S007B000	Light yellowish brown silty gravel	0	10/24/92	Settling Pond to GW
S007B010	Brown silty sand with small boulders (very limited amount of recovery)	15	10/24/92	Settling Pond to GW
S007B020	Coarse-grained sandy gravel	25	10/24/92	Settling Pond to GW
S008B000	Coarse-grained sand/pea gravel	0	10/25/92	Dewatering Pit to GW
S008B001	Gypsum	2.5	10/25/92	Dewatering Pit to GW
S008B010	Coarse-grained sandy gravel (light yellowish brown)	10	10/25/92	Dewatering Pit to GW
S008B020	Light yellowish brown silty/sandy/gravel	20	10/25/92	Dewatering Pit to GW
S008B030	Gravel (wet) various colors	26	10/25/92	Dewatering Pit to GW
S009B	Inaccessible (to be done in spring of 93). Former East Overflow Pond in use at time of drilling	NS	Inaccess-ible	Former East Overflow Pond
S010B000	Tan fine silt - dry	10.5	10/12/92	Former Pillow Tank Area
S010B002	Tan fine silt	13	10/12/92	Former Pillow Tank Area
S010B005	Tan silt	15.5	10/12/92	Former Pillow Tank Area
S010B007	Tan silt	18	10/12/92	Former Pillow Tank Area
S010B010	Tan silt	20.5	10/12/92	Former Pillow Tank Area
S011B000	Tan silt	9	10/13/92	Former Pillow Tank Area
S011B002	Tan silt	11.5	10/13/92	Former Pillow Tank Area
S011B005	Tan silt	14	10/13/92	Former Pillow Tank Area
S011B007	Tan silt	16.5	10/13/92	Former Pillow Tank Area
S011B010	Tan silt	19	10/13/92	Former Pillow Tank Area
S011R999	Rinsate	NA	10/13/92	Former Pillow Tank Area
S030B000	Road base/sandy gravel (up to 1 in.)	0.5	10/14/92	Ammo #1
S030B002		2	10/14/92	Ammo #1
S031B000	Gray brown sandy gravel (up to 1 in.)	0.5	10/14/92	Ammo #1
S031B002		NS	10/14/92	Ammo #1
S032B000	Road base/gravel (gypsum)	0.5	10/14/92	Ammo #1
S032B002	Red tan silt - moist	2	10/14/92	Ammo #1

TABLE 2.1-9 *(continued)*
SIMPLOT POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE I

Phase I Sample IDs	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S033B000	Tan sandy gravel and road base	0.5	10/14/92	Ammo #1
S033B002	Brown sandy gravel	2	10/14/92	Ammo #1
S033R999	Rinsate		10/14/92	Ammo #1
S034B000	Tan-brown sandy silt with gravel	0.5	9/18/92	Ammo #1
S034B002	Brown silty sand with fine gravel	2	9/18/92	Ammo #1
S035B000	Brown-tan silt with gravel	0.5	9/23/92	Ammo #1
S035B002	Dark brown-tan silt/sand w/gravel	2	9/23/92	Ammo #1
S036B000	Brown silty sand with fine gravel	0.5	9/23/92	Ammo #1
S036B002	Tan silt with gravel	2	9/23/92	Ammo #1
S037B000	Brown silty sand with fine gravel	0.5	9/23/92	Ammo #1
S037B002	Tan silt with gravel	2	9/23/92	Ammo #1
S038B000	Brown-tan silt	0.5	10/14/92	Ammo #2
S038B002	Tan silty sand - moist	2	10/14/92	Ammo #2
S038R999	Rinsate	NA	10/13/92	Ammo #2
S039B	Inaccessible due to utilities & building structures	NA	10/14/92	Ammo #2
S040B000	Tan sandy gravel	0.5	10/14/92	Ammo #2
S040B002	Gravel	2	10/14/92	Ammo #2
S041B000	Tan sandy gravel (up to 1 in.)	0.5	10/14/92	Ammo #2
S041B002	Gravel	2	10/14/92	Ammo #2
S042B000	Tan sandy gravel (coarse up to 1 in.)	0.5	10/13/92	Ammo #2
S042B002	Tan sandy gravel	2	10/13/92	Ammo #2
S042R999	Rinsate	NA	10/13/92	Ammo #2
S043B000	Brown tan sandy gravel (coarse up to 1 in.)	0.5	10/13/92	Ammo #2
S043B002	Sandy gravel (coarse) - 2nd run red-brown silty sand	2	10/13/92	Ammo #2
S044B000	Tan sandy gravel (1/8-1/4 in.)	0.5	10/13/92	Ammo #2
S044B002	Tan sandy gravel (coarse)	2	10/13/92	Ammo #2
S044R999	Rinsate	NA	10/13/92	Ammo #2
S045B000	Tan sandy gravel (fine <1/8 in.)	0.5	10/13/92	Ammo #2
S045B002	Tan sandy silt - damp	2	10/13/92	Ammo #2
S046B000	Dark brown sandy gravel/sand with gravel (<=1/2 in.)	0.5	10/11/92	Amm Sulfate
S046B002	Tan sandy gravel	2	10/11/92	Amm Sulfate
S047B000	Dark brown silty gravel (fine <1/8 in.)	0.5	10/11/92	Amm Sulfate
S047B002	Sandy gravel	2	10/11/92	Amm Sulfate
S048B000	Dark brown clayey silt with gravel	0.5	9/23/92	Amm Sulfate
S048B002	Dark brown clayey silt with gravel	2	9/23/92	Amm Sulfate

TABLE 2.1-9 *(continued)*
SIMPLOT POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE I

Phase I Sample IDs	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S049B000	Dark brown clayey silt with gravel	0.5	9/23/92	Amm Sulfate
S049B002	Dark brown clayey silt with gravel	2	9/23/92	Amm Sulfate
S050B000	Black-gray silty gravel	0.5	10/9/92	Triple superphosphate area
S050B002	Tan silt	2	10/9/92	Triple superphosphate area
S051B000	Dark brown silt trace fine gravel	0.5	10/9/92	Triple superphosphate area
S051B002	Brown sandy silt gravel (up to 1 in.)	2	10/9/92	Triple superphosphate area
S052B000	Brown silt with fine gravel	0.5	10/9/92	Triple superphosphate area
S052B002	Brown silt	2	10/9/92	Triple superphosphate area
S053B000	Dark brown silt with gravel	0.5	10/9/92	Triple superphosphate area
S053B002	Tan silty clay with gravel	2	10/9/92	Triple superphosphate area
S054B000	Tan gray sandy gravel	0.5	10/15/92	Phos Acid Cont
S054B002	Gypsum fill	2.5	10/15/92	Phos Acid Cont
S054R999	Rinsate	NA	10/15/92	Phos Acid Cont
S055B000	Tan-brown sandy gravel	0.5	10/16/92	Phos Acid Cont
S055B002	Tan-brown sandy gravel	2.5	10/16/92	Phos Acid Cont
S055B005	Tan sandy gravel	5	10/16/92	Phos Acid Cont
S055B007	Tan sandy gravel	7	10/16/92	Phos Acid Cont
S056B000	Dark gray silt gravel	0.5	10/14/92	Railcar Cleaning
S056B002	Dark gray silt gravel	2	10/14/92	Railcar Cleaning
S057B	Inaccessible due to new plant structures	NA	10/14/92	Railcar Cleaning
S058B000	Tan sandy gravel	0.5	10/14/92	Sulfuric Loading
S058B002	Tan silt - moist	2.5	10/14/92	Sulfuric Loading
S058B005	Tan silt	5	10/14/92	Sulfuric Loading
S058B007	Tan sand/sandy gravel (fine)	7.5	10/14/92	Sulfuric Loading
S058B010	Tan sandy gravel	10	10/14/92	Sulfuric Loading
S059B000	Tan brown sandy gravel (<=1 in.)	0.5	10/15/92	Sulfuric Loading
S059B002	Tan silt	2.5	10/15/92	Sulfuric Loading
S059B005	Tan silt	5	10/15/92	Sulfuric Loading
S059B007	Tan silt	7.5	10/15/92	Sulfuric Loading
S059B010	Tan silt - silty gravel	10	10/15/92	Sulfuric Loading
S060B000	Gray sandy gravel	0.5	10/14/92	Sulfuric Loading
S060B002	Tan silt	2.5	10/14/92	Sulfuric Loading
S060B005	Tan sandy gravel	5	10/14/92	Sulfuric Loading
S060R999	Rinsate	NA	10/14/92	Sulfuric Loading
S061B000	Tan sandy gravel (<=1 in.)	0.5	10/15/92	Sulfuric Loading

TABLE 2.1-9 *(continued)*
SIMPLOT POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE I

Phase I Sample IDs	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S061B002	Tan silt	2.5	10/15/92	Sulfuric Loading
S061B005	Tan silt (damp)	5	10/15/92	Sulfuric Loading
S061B007	Tan sandy gravel - damp	7.5	10/15/92	Sulfuric Loading
S061B010	Tan sand with gravel - damp	8	10/15/92	Sulfuric Loading
S061R999	Rinsate	NA	10/14/92	Sulfuric Loading
S062B000	Silty sand - slight odor	0.5	10/11/92	Fmr #1 Sulf Plnt
S062B002	Tan silt	2.5	10/11/92	Fmr #1 Sulf Plnt
S062B005	Tan silt	5	10/11/92	Fmr #1 Sulf Plnt
S062B007	Silty gravel	7.5	10/11/92	Fmr #1 Sulf Plnt
S062B010	Silty gravel	10	10/11/92	Fmr #1 Sulf Plnt
S063B000	Brown sandy gravel	0	10/11/92	Fmr #1 Sulf Plnt
S063B002	Sandy gravel (up to 1 in.)	2.5	10/11/92	Fmr #1 Sulf Plnt
S063B005	Sandy gravel	5	10/11/92	Fmr #1 Sulf Plnt
S063B007	Refusal-Cobbles (1-2 in.)	7.5	10/11/92	Fmr #1 Sulf Plnt
S063R999	Rinsate	NA	10/11/92	Fmr #1 Sulf Plnt
S064B000	Tan sandy gravel	0.5	10/11/92	Fmr #2 Sulf Plnt
S064B002	Decomposed tuff boulder/sandy gravel	2.5	10/11/92	Fmr #2 Sulf Plnt
S064B005	Brown silt	5	10/11/92	Fmr #2 Sulf Plnt
S065B000	Brown sand with trace gravel	0.5	10/11/92	Fmr #2 Sulf Plnt
S065B002	Tan silt	2.5	10/11/92	Fmr #2 Sulf Plnt
S065B005	Tan-brown silt	5	10/11/92	Fmr #2 Sulf Plnt
S065B007	Tan-brown silt	7.5	10/11/92	Fmr #2 Sulf Plnt
S065R999	Rinsate	NA	10/11/92	Fmr #2 Sulf Plnt
S066B000	Brown silty gravel (fine - coarse)	0.2	10/11/92	Phos Acid Loading
S066B002	Tan brown silty gravel (coarse up to 2 in.)	2.5	10/11/92	Phos Acid Loading
S066B005	Silty gravel	4	10/11/92	Phos Acid Loading
S067B000	Brown silty gravel	0.5	10/11/92	Phos Acid Loading
S067B002	Tan-brown silty gravel	2.5	10/11/92	Phos Acid Loading
S068B000	Brown sandy silt with trace gravel	0	10/8/92	Cooling Tower Area
S068B002	Silty gravel	2.5	10/8/92	Cooling Tower Area
S068B005	Brown sandy gravel (fine)	5	10/8/92	Cooling Tower Area
S068B007	Sandy gravel (fine <=1/4, mostly 1/8 or smaller) damp	7.5	10/8/92	Cooling Tower Area
S068B010	Gravel	9	10/8/92	Cooling Tower Area
S069B000	Dark brown silty sand trace gravel	0	10/8/92	Cooling Tower Area

TABLE 2.1-9 *(continued)*
SIMPLOT POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE I

Phase I Sample IDs	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S069B001	Gray gypsum	0.5	10/8/92	Cooling Tower Area
S069B002	Tan silt	2	10/8/92	Cooling Tower Area
S070B000	Dark brown silt - damp	0	10/9/92	Former Cooling Pond
S070B002	Tan sandy gravel	2.5	10/9/92	Former Cooling Pond
S070B005	Tan sand-gravel (< gravel) tuff boulder	5	10/9/92	Former Cooling Pond
S070B007	Tan silty sand	7.5	10/9/92	Former Cooling Pond
S070B010	Tan silty sand	10	10/9/92	Former Cooling Pond
S071B000	Dark brown sandy silt tr/gravel (damp)	0	10/9/92	Former Cooling Pond
S071B002	Gray black wet silt	2.5	10/9/92	Former Cooling Pond
S071B005	Gray black silt - sandy gravel	5	10/9/92	Former Cooling Pond
S071B007	Tan silty sand with trace gravel	7.5	10/9/92	Former Cooling Pond
S071B010	Silty sand	10	10/9/92	Former Cooling Pond
S072B000	Dark brown silty gravel	0	10/10/92	Water Reclaim Area
S072B002	Tan silt to 1.8 ft. - tan sandy gravel	3	10/10/92	Water Reclaim Area
S073B000	Dark brown sand with gravel	0	10/10/92	Water Reclaim Area
S073B002	Tan sandy silt	3.5	10/10/92	Water Reclaim Area
S074B000	Brown sandy silt with trace gravel (1/4 or smaller)	0.5	10/9/92	Former Ore Pile Area
S074B002	Tan-brown silt	2	10/9/92	Former Ore Pile Area
S075B000	Tan silt with trace fine gravel	0.5	10/9/92	Former Ore Pile Area
S075B002	Tan-brown silt	2	10/9/92	Former Ore Pile Area
S076B000	Brown silt with trace gravel	0	10/10/92	Former Ore Pile Area
S076B002	Tan-brown silt	2	10/10/92	Former Ore Pile Area
S077B000	Dark red brown silt with gravel	0	10/10/92	Former Ore Pile Area
S077B002	Tan silt	2	10/10/92	Former Ore Pile Area
S078B000	Red-brown fine silt	0	10/10/92	Former Ore Pile Area
S078B002	Tan silt	2	10/10/92	Former Ore Pile Area
S079B000	Dark brown sandy silt with gravel (<=1/8 to 1/4 in.)	0	10/10 & 15	Bone Yard
S079B002	Tan silt	2	10/10 & 15	Bone Yard
S080B000	Brown sandy silt	0	10/10 & 15	Bone Yard
S080B002	Brown-tan silt	2	10/10 & 15	Bone Yard
S081B000	Tan-brown silt trace fine gravel	0	10/10 & 15	Bone Yard
S081B002	Tan-brown silt	2	10/10 & 15	Bone Yard
S082B000	Tan silt	0.5	11/12/92	Road Sample
S082B002	Brown-tan silt	2	11/12/92	Road Sample
S083B000	Tan-brown silt	0.5	11/12/92	Road Sample

TABLE 2.1-9 *(continued)*
SIMPLOT POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE I

Phase I Sample IDs	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S083B002	Tan-brown silt	2	11/12/92	Road Sample
S084B000	Light tan fine silt	0.5	11/12/92	Road Sample
S084B002	Light tan fine silt	2	11/12/92	Road Sample
S085B000	Brown silt sand with gravel	0	10/10/92	Road Sample
S085B002	Tan-brown silt to silty sandy gravel	2	10/10/92	Road Sample
S086B000	Tan-brown silt trace gravel	0	10/10/92	Road Sample
S086B002	Tan silt	2	10/10/92	Road Sample
S087B000	Dup with S067B000		10/10/92	Road Sample
S087B002	Dup with S067B002-Refusal		10/10/92	Road Sample
S088B000	Red-brown sandy silt with gravel	0.5	10/10/92	Road Sample
S088B002	Brown silt	2	10/10/92	Road Sample
S089B000	Red-brown sandy silt with gravel	0	10/10/92	Road Sample
S089B002	Brown silt	2	10/10/92	Road Sample
S090B000	Red-brown silt trace gravel	0.5	10/10/92	Road Sample
S090B002	Brown silt	2	10/10/92	Road Sample
S091B000	Dup with S063B000		10/10/92	Road Sample
S091B002	Dup with S063B002		10/10/92	Road Sample
S091R999	Rinsate	NA	10/11/92	Road Sample
S092B000	Inaccessible - center of plant underground utilities	NS	10/11/92	Road Sample
S092B002	Inaccessible - center of plant underground utilities	NS	10/11/92	Road Sample
S093B000	Brown silt with trace gravel	0	10/10/92	Road Sample
S093B002	Tan silt	2	10/10/92	Road Sample
S094B000	Gray gypsum	0.5	10/8/92	Road Sample
S094B002	Tan-brown silt	2	10/8/92	Road Sample
S095B000	Dark brown sandy silt with fine gravel	0	10/10/92	Road Sample
S095B002	Tan silt (moist in shoe)	2	10/10/92	Road Sample
S096B000	Tan-brown silt	0.5	10/12/92	Road Sample
S096B002	Tan silt	2	10/12/92	Road Sample

TABLE 2.1-9 *(continued)*
SIMPLOT POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE II

Phase II Sample IDs	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S097B000	Silty gravel	0	7/14/93	Unlined ditch
S097B002	Sandy gravel	2	7/14/93	Unlined ditch
S097B005	Gravel	NS	7/14/93	Unlined ditch
S097B007	Sandy gravel	7	7/14/93	Unlined ditch
S097B010	Silty sandy gravel	10	7/14/93	Unlined ditch
S097B015	Silty gravel	15	7/14/93	Unlined ditch
S097B020	Sandy gravel	20	7/14/93	Unlined ditch
S097B025	Gravel	25	7/14/93	Unlined ditch
S097B030	Gravels (wet)	NS	7/14/93	Unlined ditch
S098B000	Sandy gravel	0.5	7/9/93	Triple superphosphate area
S098B002	Tan silt	2	7/9/93	Triple superphosphate area
S098B005	Tan silt	5	7/9/93	Triple superphosphate area
S098B007	Tan silt	7	7/9/93	Triple superphosphate area
S098B010	Tan silt (wet)	10	7/9/93	Triple superphosphate area
S099B000	Gypsum fill	0	7/12/93	Downgradient of EOP
S099B010	Sandy gravel	10	7/12/93	Downgradient of EOP
S099B020	Gravel	NS	7/12/93	Downgradient of EOP
S099B030	Sandy gravel	30	7/12/93	Downgradient of EOP
S099B040	Gravel	NS	7/12/93	Downgradient of EOP
S099B050	Gravel	50	7/12/93	Downgradient of EOP
S099R999	Rinsate	NA	7/13/93	Bechtel Trailer
S100B000	Gravelly sandy silt	0	7/11/93	Former Cooling Pond
S100B002	Tan silt	2	7/11/93	Former Cooling Pond
S100B005	Fill (sandstone)	5	7/11/93	Former Cooling Pond
S100B007	Fill (sandstone)	7	7/11/93	Former Cooling Pond
S100B010	Fill (sandstone)	10	7/11/93	Former Cooling Pond
S100B012	Fill (sandstone)	12	7/11/93	Former Cooling Pond
S100B015	Sandy gravel	15	7/11/93	Former Cooling Pond
S100B025	Gravel	25	7/11/93	Former Cooling Pond
S100B035	Gravel	NS	7/11/93	Former Cooling Pond
S100B045	Gravel	45	7/11/93	Former Cooling Pond
S100B055	Tan silt	55	7/11/93	Former Cooling Pond
S100B065	Sandy gravel	65	7/11/93	Former Cooling Pond
S100B080	Clay	80	7/11/93	Former Cooling Pond
S101B000	Gravel	0	7/10/93	Cooling Tower

TABLE 2.1-9 *(continued)*
SIMPLOT POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE II

Phase II Sample IDs	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S101B002	Sandy gravel	2	7/10/93	Cooling Tower
S101B005	Silty gravel	5	7/10/93	Cooling Tower
S101B007	Sandy gravel	7	7/10/93	Cooling Tower
S101B010	Silty sandy gravel	10	7/10/93	Cooling Tower
S101B012	Sandy gravel	12	7/10/93	Cooling Tower
S101B015	Silty sandy gravel	15	7/10/93	Cooling Tower
S101B017	Tan silty gravel	17	7/10/93	Cooling Tower
S101B020	Silty sandy gravel	NS	7/10/93	Cooling Tower
S101R999	Rinsate	NA	7/10/93	@ Cooling Tower
S102B000	Silty sandy gravel	0	7/12/93	Water Reclaim
S102B002	Gravelly tan silt	2	7/12/93	Water Reclaim
S102B005		NS	7/12/93	Water Reclaim
S102B007	Tan silt	7	7/12/93	Water Reclaim
S102B010	Sandy gravel	10	7/12/93	Water Reclaim
S102B012	Gravel	NS	7/12/93	Water Reclaim
S102B015	Sandy gravel	15	7/12/93	Water Reclaim
S102B017	Sandy gravel	NS	7/12/93	Water Reclaim
S102B020	Sandy gravel	20	7/12/93	Water Reclaim
S103B000	Sandy gravel	0	7/13/93	RR Clean-out
S103B002	Sandy gravel	2	7/13/93	RR Clean-out
S103B005	Gravelly silt	5	7/13/93	RR Clean-out
S103B007	Gravelly silt	7	7/13/93	RR Clean-out
S103R999	Rinsate	NA	7/13/93	RR Clean-out
S104B000	Gravelly silt	0	7/24/93	Fmr #1 Sulf Plnt
S104B005	Tan silt	5	7/24/93	Fmr #1 Sulf Plnt
S104B010	Silty sandy gravel	10	7/24/93	Fmr #1 Sulf Plnt
S104B015	Gravel	15	7/24/93	Fmr #1 Sulf Plnt
S104B020	Gravel	20	7/24/93	Fmr #1 Sulf Plnt
S104B025	Sandy gravel	25	7/24/93	Fmr #1 Sulf Plnt
S104B030	Gravels	NS	7/24/93	Fmr #1 Sulf Plnt
S104B040	Gravels	NS	7/24/93	Fmr #1 Sulf Plnt
S105B000	Silty sandy gravel	0.5	7/24/93	Phos Acid Loading
S105B002	Gravelly silt	2	7/24/93	Phos Acid Loading
S105B005	Tan silt	5	7/24/93	Phos Acid Loading
S105B007	Silty sandy gravel	7	7/24/93	Phos Acid Loading

TABLE 2.1-9 *(continued)*
SIMPLOT POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE II

Phase II Sample IDs	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S105B010	Sandy gravel	10	7/24/93	Phos Acid Loading
S105B015	Gravel	15	7/24/93	Phos Acid Loading
S105B020	Gravels	NS	7/24/93	Phos Acid Loading
S105B025	Gravels	NS	7/24/93	Phos Acid Loading
S105R999	Rinsate	NA	7/25/93	@ Phos Acid Loading
S106B000	Tan silt	0.5	7/10/93	Ammo #1
S106B002	Tan silt	2	7/10/93	Ammo #1
S106B005	Tan silt	5	7/10/93	Ammo #1
S106B007	Tan silt	7	7/10/93	Ammo #1
S106B010	Sandy gravel	10	7/10/93	Ammo #1
S107B000	Brown silty sandy gravel	0	7/10/93	Ammo #1 Loading
S107B002	Gravelly silt	2	7/10/93	Ammo #1 Loading
S107B005	Gravelly silt	NS	7/10/93	Ammo #1 Loading
S107B007	Sandy gravel	7	7/10/93	Ammo #1 Loading
S107B010	Sandy gravel	10	7/10/93	Ammo #1 Loading
S107B012	Sandy gravel	NS	7/10/93	Ammo #1 Loading
S108B000	Tan silt	0	7/9/93	Ammo #2
S108B002	Tan silt	2	7/9/93	Ammo #2
S108B005	Sandy gravel	5	7/9/93	Ammo #2
S108B007	Sandy gravel	7	7/9/93	Ammo #2
S108B010	Sandy gravel	10	7/9/93	Ammo #2
S109B000	Silty gravel	0	7/13/93	Phos Storage Loading
S109B002	Tan silt	2	7/13/93	Phos Storage Loading
S109B005	Gravelly sand	5	7/13/93	Phos Storage Loading
S109B007	Gravel	NS	7/13/93	Phos Storage Loading
S109B010	Sandy gravel	10	7/13/93	Phos Storage Loading
S109B015	Gravel	15	7/13/93	Phos Storage Loading
S109B020	Gravel	20	7/13/93	Phos Storage Loading
S332B070	Gravel	70	7/9/93	Well upgradient of EOP
S333B160	Sandy gravel	160	7/19/93	Simplot Fenceline well

TABLE 2.1-9 *(continued)*
SIMPLOT POTENTIAL SOURCE AND FACILITY SOIL BORING SUMMARY

PHASE II

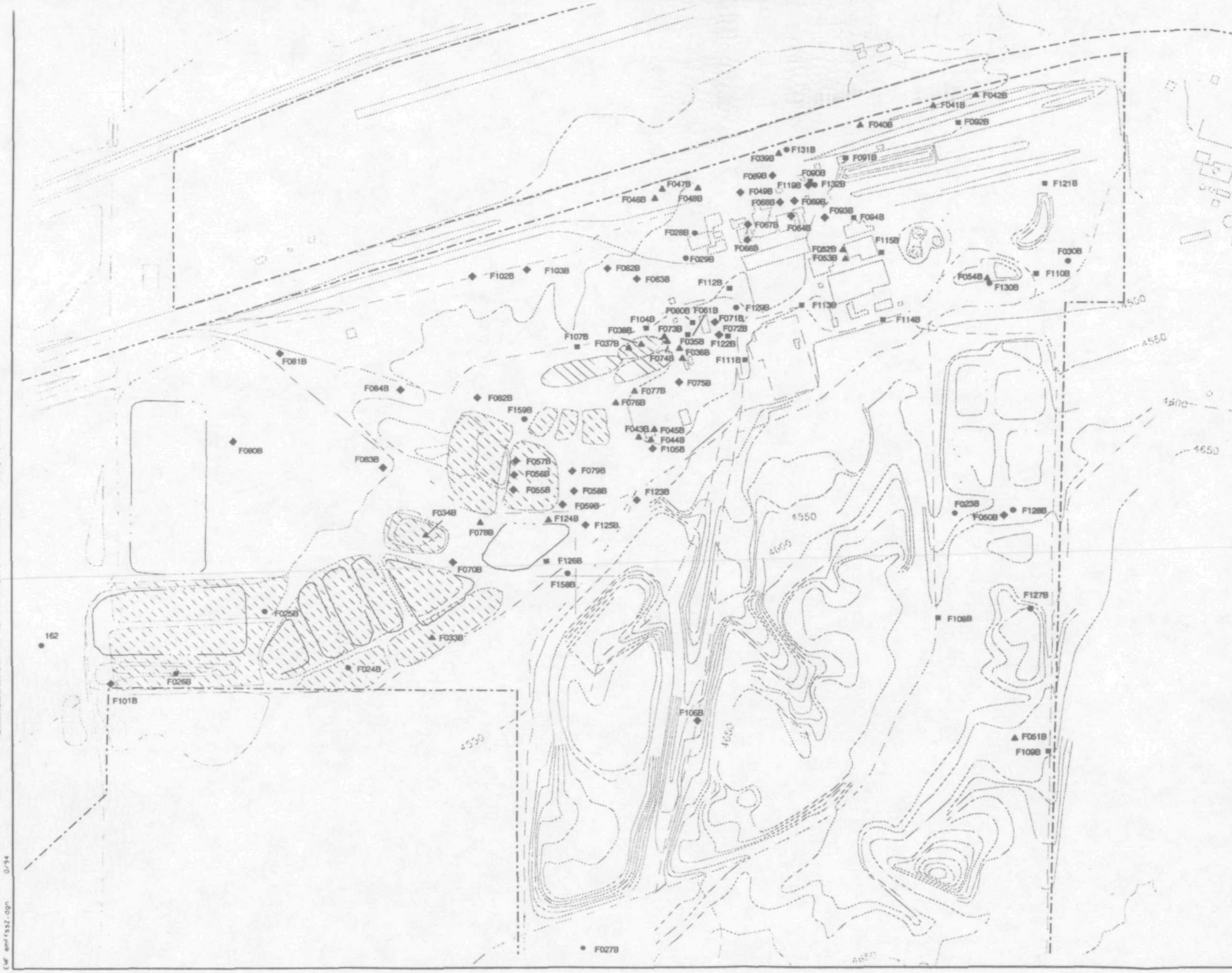
Phase II Sample IDs	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
	PCB Road Resampling Locations			
S063B000	Sandy gravel	0	8/5/93	Fmr #1 Sulf Plnt
S067B000	Silty gravel	NS	8/5/93	Phos Acid Loading
S079B000	Sandy silt w/ gravel	0	8/5/93	Bone Yard
S080B000	Brown sandy silt	0	8/5/93	Bone Yard
S085B000	Silt sand w/ gravel	0	8/5/93	Road Sample
S088B000	Sandy silt w/ gravel	0.5	8/5/93	Road Sample
S090B000	Brown silt	0.5	8/5/93	Road Sample
S094B000	Gypsum	0.5	8/5/93	Road Sample
S098B000	Sandy gravel	0.5	8/5/93	Triple Superphosate area
	Separate data group - groundwater from borings			
S100W085	Groundwater screening	NA	7/11/93	Former Cooling Pond
S099W059	Groundwater screening	NA	7/12/93	Former East Overflow Pond
S097W035	Groundwater screening	NA	7/14/93	Unlined Ditch
S097WRRA	Rinsate	NA	7/14/93	QA/QC
S097WRRB	Rinsate	NA	7/14/93	Matrix Spike
S097WRRC	Rinsate	NA	7/14/93	Matrix Spike Dup

Notes: NA = Not applicable.
NS = Not sampled.

TABLE 2.1-10
ANALYTICAL PARAMETERS FOR GROUNDWATER GRAB SAMPLES

I.	**Heavy Metals**
	Aluminum
	Antimony
	Arsenic
	Barium
	Beryllium
	Boron
	Cadmium
	Chromium
	Cobalt
	Copper
	Iron
	Lead
	Lithium
	Manganese
	Mercury
	Molybdenum
	Nickel
	Selenium
	Silver
	Thallium
	Vanadium
	Zinc
II.	**General Water Quality Parameters**
	Alkalinity (bicarbonate)
	Alkalinity (carbonate)
	Ammonia
	Calcium
	Chloride
	Conductivity
	Fluoride
	Magnesium
	Nitrate
	pH
	Phosphorus (total)
	Phosphorus (orthophosphate)
	Potassium
	Sodium
	Sulfate
	Temperature
	Total Dissolved Solids
III.	**Radionuclides**
	Gross Alpha
	Gross Beta

Surface and Subsurface Characterizations
Figures for Section 2.1



Legend:

Maximum Sample Depth

- ■ 0 - 2.5
- ◆ 2.5 - 10
- ▲ 10 - 50
- ● to groundwater
- Former pond location
- FMC Property Lines

Note:

Borings F127B, F128B, F129S, F130B, F131B, F132S, F158B, and F159B are Phase II borings.

Boring 162 is a Phase III boring.

N

0 600 1200 FEET

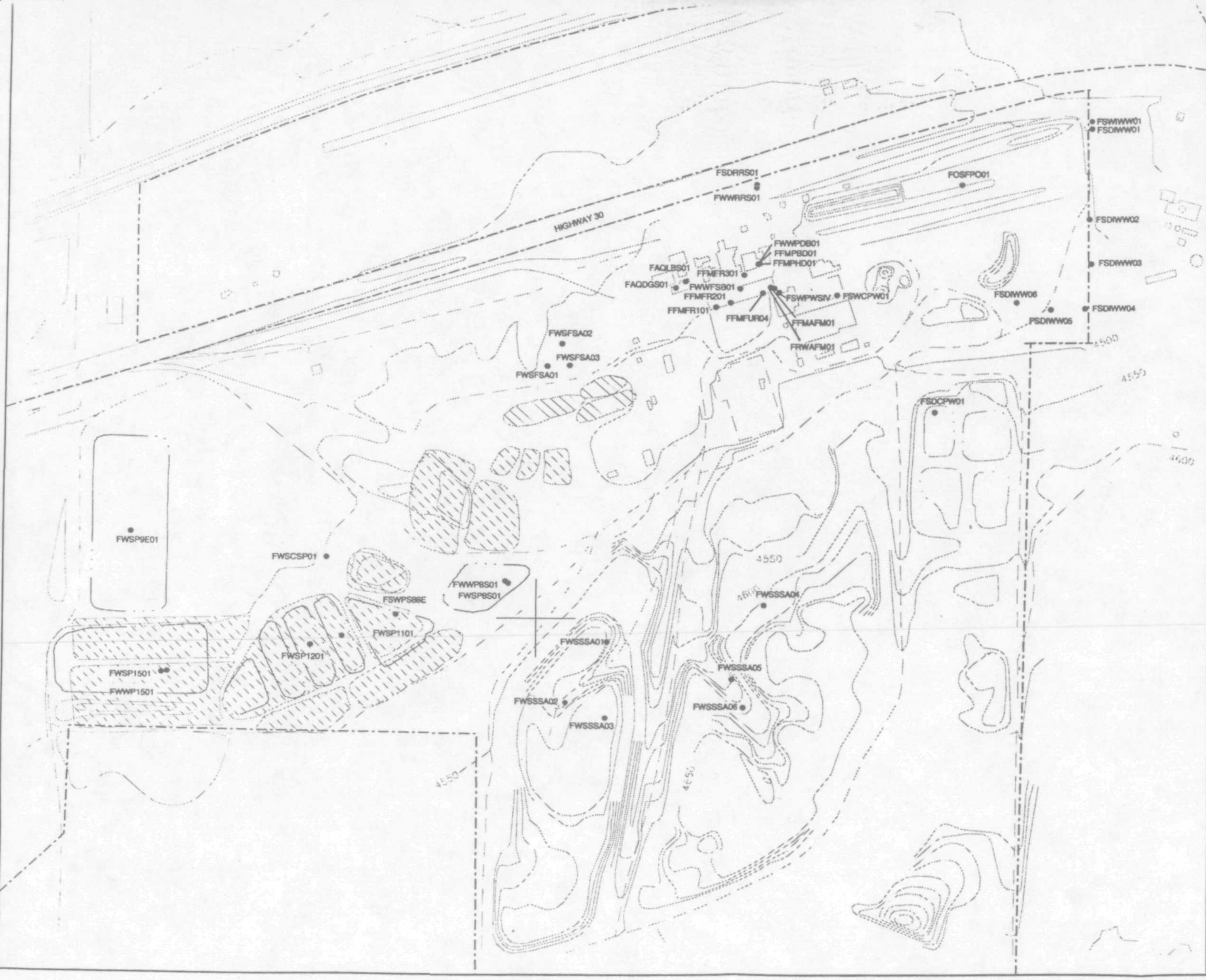
0 100 200 300 400 METERS

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

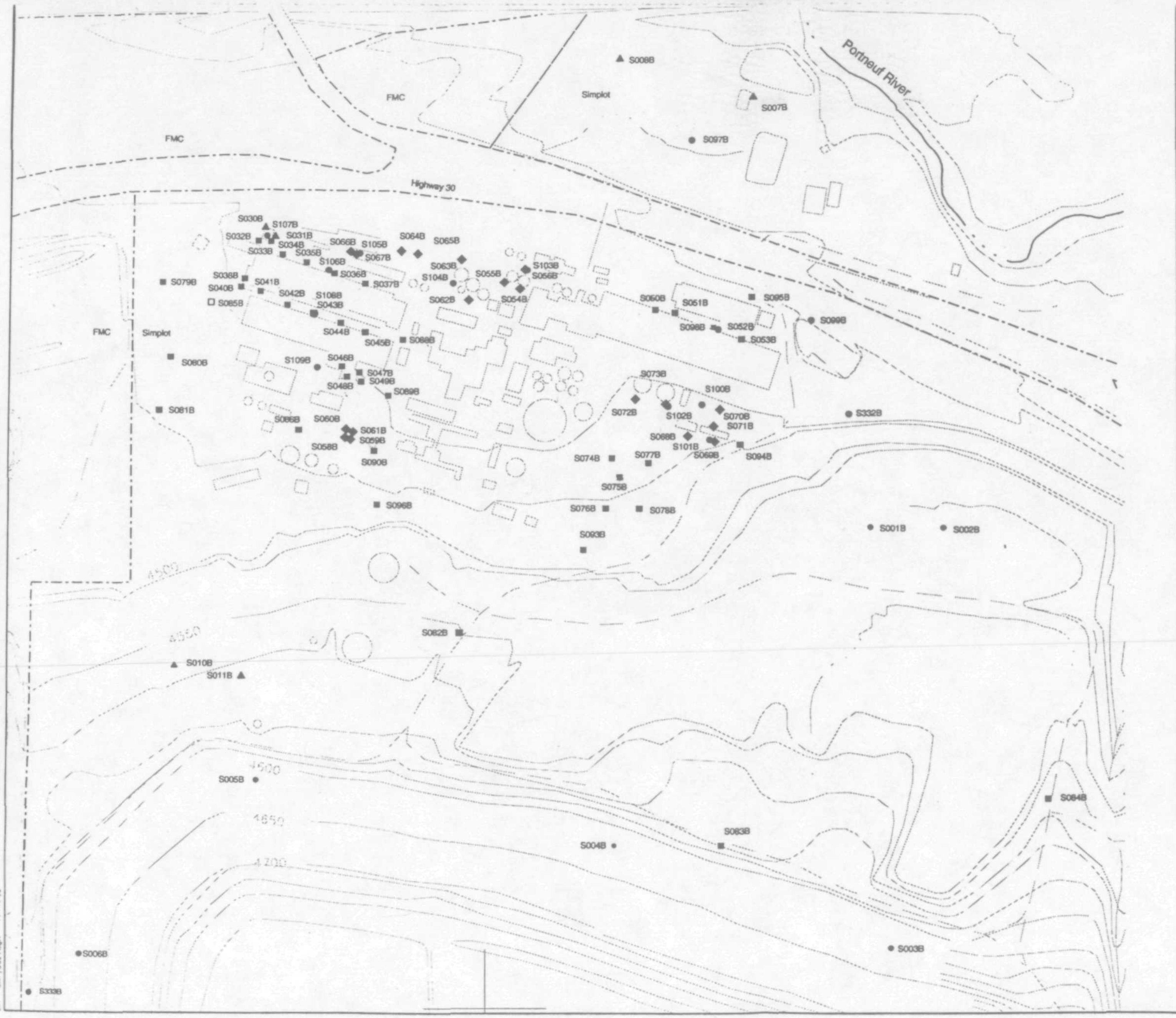
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Soil Boring Locations - FMC Facility

Job Number	Drawing No.	Rev.
21372	FIGURE 2.1-1	



BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Potential Source Sample Locations - FMC Facility		
Job Number	Drawing No.	Rev.
21372	FIGURE 2.1-2	



Legend:

Property Lines

Maximum Sampling Depth:

■ 0 - 2.5 ft.

◆ 2.5 - 10 ft.

▲ 10 - 50 ft.

● to groundwater (depth is variable)

Note:

Borings S9097B through S109B and S332B and S333B are Phase II borings.

N

0 400 800 FEET

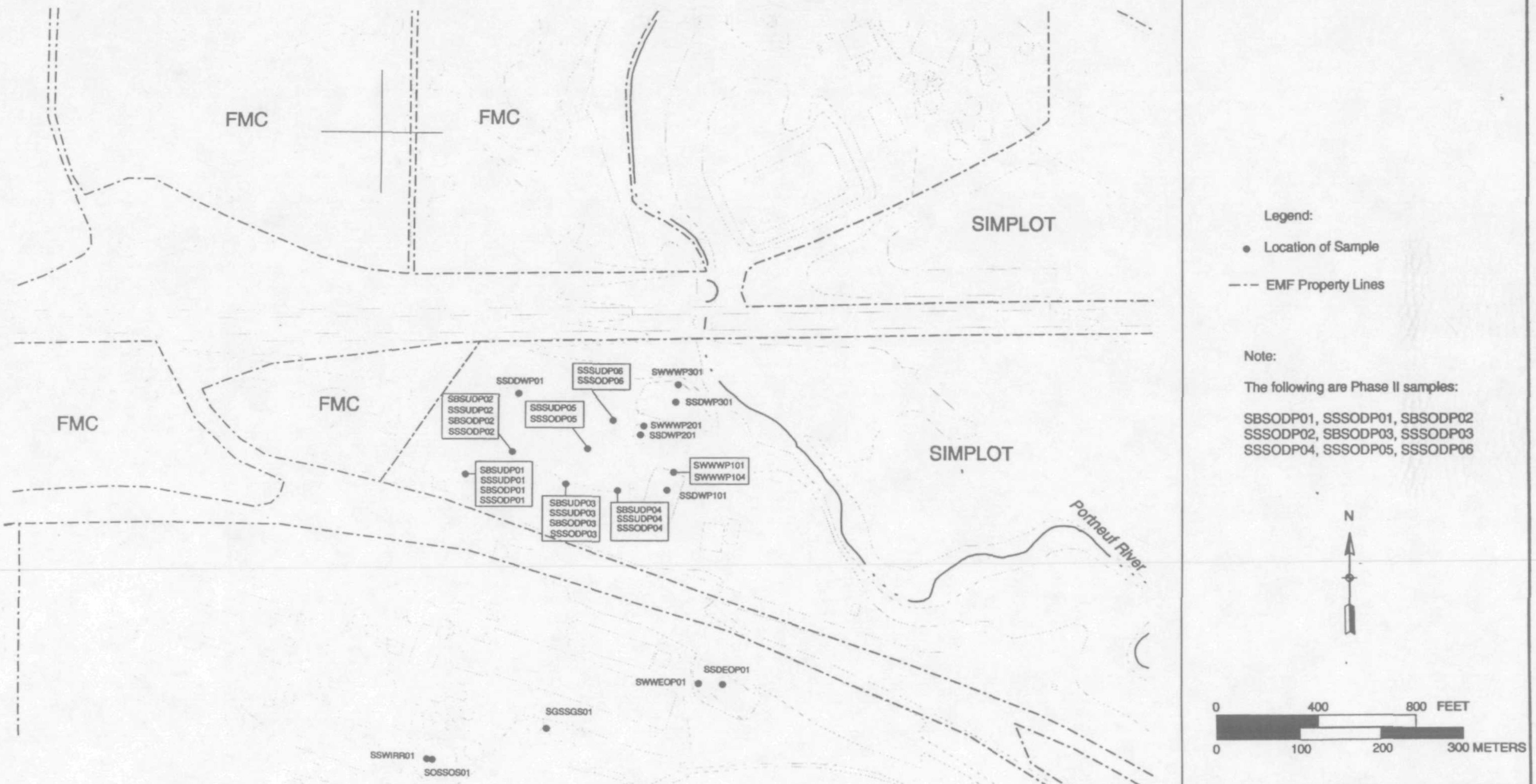
0 100 200 300 METERS

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Soil Boring Locations - Simplot Facility

Job Number	Drawing No.	Rev.
21372	FIGURE 2.1-3	



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EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Potential Source Sample Locations - Simplot Facility

Job Number	Drawing No.	Rev.
21372	FIGURE 2.1-4	

2.2 SURFACE SOIL INVESTIGATION

The objectives of the surface soil investigation in the EMF study area were to:

- Establish current levels of chemicals and radionuclides over a broad area of surface soils in the vicinity of the EMF facilities
- Identify trends, if any, in surface soil concentrations related to soil associations and distance from the EMF facilities
- Assess the degree to which air emissions from the EMF facilities may have impacted soils in the area

In Phase I, the surface soil sampling program:

- Sampled the major soil associations in the EMF study area at the surface (0 to 2 inches) and at a depth of 2 to 2.5 feet
- Provided data about the areal distribution of chemicals in the vicinity of the facilities

The Phase II surface soil sampling program augmented Phase I information to:

- Further delineate the distribution of soil constituents immediately north of the EMF facilities
- Increase the sample location density southwest (predominantly upwind) of the EMF facilities
- Resample specific locations for which Phase I investigation data were anomalous

2.2.1 SAMPLING LOCATION SELECTION PROCESS

Sixteen equally spaced transects were extended from a center point located at the northern end of the fenceline between the FMC and Simplot facilities. Sample locations were then selected along the transects in a pattern whereby the intervals between the sampling points increased with distance from the center point. Four sample locations were identified at regular intervals within the first mile, three locations within the second mile, and two locations within the third mile. This distribution pattern was based on previous studies of the vicinity, which indicated that the highest levels of metals and fluoride had been found in soils and vegetation within 1 mile of the EMF facilities (USGS, 1977; Simplot, 1990).

A completely systematic grid sampling program would have produced a number of sample locations within the operating plant boundaries. Because this investigation was designed to target undisturbed soils, no samples were located within the facility boundaries. (All surface soil sampling within the FMC and Simplot facility boundaries is described in Section 2.1.) The sampling points were extended to the fourth mile to the south of the facilities because the facility boundaries extend the farthest in that direction. The sample locations were adjusted and new locations added on the basis of the following considerations:

- Soil type
- Topography
- Land use

A subset of these sample locations, forming a "checkerboard" design, was selected for radiological analysis.

Supplemental samples of soil north of the site were collected to assess the distribution of constituents. The locations of the sampling points are shown in Figures 2.2-1 and 2.2-2. A summary of samples collected is presented in Table 2.2-1.

Because of EPA's concern that surface soil sampling density in the southwest direction (predominantly upwind) was not sufficient, eight additional samples were collected in this quadrant at distances of up to 3 miles (4.8 km) from the facility boundaries during Phase II (Figure 2.2-1). Samples were collected at the surface and at a depth of 2 feet where possible. In addition, five Phase II surface soil samples were collected from an area southeast of the site in the general region of Pocatello. This area also lies in a prevailing upwind direction.

Finally, polonium-210 was detected 2 feet below the surface at location 315-3B (Figure 2.2-1), but not in the surface sample. To confirm the presence of polonium-210 at this location and depth, this location was resampled during Phase II. Resample results are provided in Section 4.3.

2.2.1.1 Soil Types

Separate soil surveys have been conducted by the U.S. Soil Conservation Service (SCS) in the Fort Hall and Bannock County areas. While soil-naming conventions differ between the published reports, there appears to be a strong similarity between the major soil associations defined by the SCS (1977, 1987a) for each area. For purposes of this soil sampling program, soil associations with similar characteristics were considered as one (Table 2.2-2).

RI sample locations were selected in each major soil association because levels of naturally occurring metals and radionuclides may differ from one soil association to another. Samples were collected in areas least likely to have been disturbed by agriculture or other land uses.

The locations of the surface-soil sampling points, together with the soil associations for both Fort Hall and Bannock County soil surveys are shown in Figure 2.2-3. There is an average of 10 sampling locations per soil association, with a range from 1 to 21. One hundred eight locations were sampled.

2.2.1.2 Topography

The region southeast of the EMF facilities contains topographic high points which may be areas particularly susceptible to aerial deposition caused by local meteorological conditions. Sampling locations in this region were adjusted to include locations on these topographic highs.

2.2.1.3 Land Use

Collecting undisturbed samples was difficult in some areas because of current land use practices. Sample locations were selected to reflect undisturbed conditions to the extent possible.

"Undisturbed" refers to the absence of chemical or physical influences from agricultural or other human activities. "Impacted" describes soils that may have been subjected to aerial deposition. In many areas, it was not possible to find undisturbed conditions in the selected surface sampling locations. In these areas, sampling locations were adjusted on the basis of available information about land use combined with field observations. These locations were chosen in an order of preference from most-preferred to least-preferred as indicated below:

- Unused/undisturbed (e.g., Bureau of Land Management [BLM] land, private property)
- Agricultural fields (samples taken at the edge of fields in areas of least disturbance and minimum fertilizer usage)
- Other land use (e.g., roadsides, parks, yards, airport)

It is difficult to obtain undisturbed samples in highly residential areas. The southeastern portion of the sampling region extends into the City of Pocatello. These areas were identified from available maps, and the sample locations adjusted accordingly.

2.2.2 SAMPLING AND ANALYSIS PROCEDURES

This section describes the documentation, sampling, and decontamination procedures followed during the surface-soil sampling investigation. The section also describes the laboratory procedures used for chemical and radiological analyses of the samples collected. These procedures were followed for both Phase I and Phase II sampling, except where noted.

2.2.2.1 Field Documentation

The surface-soil sampling program adhered to the EMF SAP (Bechtel, 1992a). Field sampling personnel maintained field log books that contained the following information:

- Sample identification numbers
- Sample collection dates and approximate times
- Sample matrix

- Sample location and depth
- Sample appearance
- Type of sampling equipment used
- Sampler's name
- Chain-of-custody number

A label was affixed to each individual sample collected and included the following information:

- Project name and location
- Project number
- Date
- Time
- Sampler's initials
- Sample identification number
- Analysis required and preservative used

To ensure quality control, rinsate samples were collected after decontamination of the soil sampling equipment. One rinsate sample was collected at every twentieth soil sample location. Rinsate samples were collected using the following procedure:

- All equipment to be used was gathered at the sample location.
- The trowel was placed inside the auger and over the stainless steel sieve and pan.
- Deionized water was poured over the trowel and auger into the stainless steel sieve and pan.
- The rinsate water was then immediately transferred to either a decontaminated plastic bowl or new plastic bag.
- Rinsate solution was transferred into the appropriate sample jars.

This entire procedure took approximately 10 to 20 minutes. The rinsate samples were preserved by the same methods used for other water samples and then shipped to the laboratory for analysis. Logging and chain-of-custody procedures were the same as those used for the soil samples. Rinsate samples were analyzed for the parameters listed in Table 2.2-3.

2.2.2.2 Soil Sampling Procedures

At each sampling location, a center point was staked and recorded using a global positioning system (GPS) satellite location. Differential correction of the GPS satellite location provided a final accuracy within approximately ± 33 feet of the true planar location. Four subsampling points were selected at random from undisturbed areas (or the least disturbed areas) within a 20-foot radius of the center of the sample location. A stainless steel trowel was used to clear the vegetation at each point, and approximately 200 grams of soil (equal aliquots) were collected per point. The four subsamples were then composited in the field by thorough mixing in a new, sealable plastic bag or a decontaminated plastic bowl.

At each subsurface location, a stainless steel hand auger was used to collect a sample from a depth of approximately 2 to 2.5 feet near the center of the four surface sample points. If, due to bedrock or rocky soil conditions, a sample could not be obtained starting at the 1.5-foot depth, the sampler attempted, at a minimum, six other pilot holes within a 100-foot radius of the center of the sampling location. Samples collected between 1.5 and 2 feet were noted in the field log as abnormal samples.

All soil samples were thoroughly mixed and passed through a number 4 sieve (approximately the size of coarse sand) to remove the larger soil particles that were less likely to have been transported by wind. The finer fractions were transferred into precleaned wide-mouth 250-ml glass jars and packaged for shipment to the laboratory for analysis. Sample custody procedures are described in Part II, Section 3 of the SAP (Bechtel, 1992a).

2.2.2.3 Decontamination of Sampling Equipment

After use, all sampling equipment was decontaminated by:

- Spraying with a solution of deionized water and phosphate-free detergent

- Scrubbing with a steel or plastic brush
- Spraying again with deionized water and phosphate-free detergent
- Rinsing thoroughly with deionized water
- Drying by hand with paper towels or by air
- Sealing in plastic bags or containers until further use

All decontamination solutions were contained and disposed of in the Simplot wastewater treatment system.

2.2.2.4 Chemical and Radiological Analyses

All soil samples collected during the surface soils investigation were analyzed for trace metals, fluoride, and total phosphorus. Specific analytes are listed in Table 2.2-3. Selected samples were also analyzed for potassium-40, lead-210, uranium-238, and polonium-210. Chemical analyses were conducted by MSAI, and radiological analyses were conducted by GEL.

All analytical methods were performed in accordance with the RI/FS Work Plan (Bechtel, 1992a), and the SAP (Bechtel, 1992b).

TABLE 2.2-1
SURFACE SOIL SAMPLE SUMMARY

PHASE I

Phase I Sample ID	SS Chem	SS Rad	BS Chem	BS Rad	Date Sampled	Land Use
SS/BS 000 1 A	1	1	1	1	7/24/92	Not in use
SS/BS 000 1 B	1		1		7/24/92	Not in use
SS/BS 000 1 C	1	1	1	1	7/30/92	Agriculture
SS 000 1 D	1				7/30/92	Agriculture
SS/BS 000 2 A	1	1	1	1	7/31/92	Park
SS/BS 000 2 B	1		1		8/3/92	Canal
SS/BS 000 2 C	1	1	1	1	8/4/92	Private/Pasture/Horse
SS/BS 000 3 A	1		1		8/5/92	Canal
SS/BS 000 3 B	1	1	1	1	8/5/92	Private/Pasture
SS/BS 023 1 A	1		1		7/24/92	Not in use
SS/BS 023 1 B	1	1	1	1	7/24/92	Not in use
SS 023 1 C	1				7/30/92	Not in use
SS 023 1 D	1	1			7/31/92	Park
SS/BS 023 2 A	1		1		8/3/92	Private/Pasture
SS/BS 023 2 B	1	1	1	1	8/3/92	Canal
SS/BS 023 2 C	1		1		8/3/92	Private/Day Care
SS/BS 023 3 A	1	1	1	1	8/4/92	Private/Pasture/Horse
SS 023 3 B	1				8/4/92	Private/Pasture/Horse
SS/BS 045 1 A	1	1	1	1	7/24/92	Not in use
SS/BS 045 1 B	1	1	1	1	7/24/92	Not in use
SS 045 1 C	1	1			7/30/92	Not in use
SS 045 1 D	1				7/31/92	Park
SS/BS 045 2 A	1	1	1	1	7/31/92	Not in use
SS/BS 045 2 B	1		1		7/31/92	Canal
SS 045 2 C	1	1			7/31/92	Private-undist.
SS/BS 045 3 A	1		1		8/5/92	Private
SS/BS 045 3 B	1	1	1	1	8/5/92	Road/Canal
SS/BS 068 1 A	1		1		7/25/92	Not in use
SS/BS 068 1 B	1	1	1	1	7/25/92	US-86
SS/BS 068 1 C	1		1		7/25/92	Wastewater
SS/BS 068 1 D	1	1	1	1	7/31/92	Wastewater
SS/BS 068 2 A	1		1		7/31/92	Private/Pasture/Horse
SS/BS 068 2 B	1	1	1	1	8/5/92	Private/Pasture/Horse
SS/BS 068 2 C	1		1		7/31/92	Private/Pasture/Sheep
SS/BS 068 3 A	1		1		8/5/92	Canal
SS/BS 068 3 B	1	1	1	1	8/5/92	Private
SS/BS 090 1 B	1	1	1	1	7/20/92	US-30
SS/BS 090 1 C	1		1		7/20/92	Park
SS/BS 090 1 D	1	1	1	1	7/20/92	Park
SS/BS 090 2 A	1		1		7/30/92	Agriculture
SS 090 2 B	1	1			8/7/92	Quarry

TABLE 2.2-1 *(continued)*
SURFACE SOIL SAMPLE SUMMARY

PHASE I

Phase I Sample ID	SS Chem	SS Rad	BS Chem	BS Rad	Date Sampled	Land Use
SS 090 2 C	1				8/7/92	Residential
SS/BS 090 3 A	1	1	1	1	8/7/92	Residential/agriculture
SS/BS 090 3 B	1		1		8/6/92	Pasture
SS/BS 113 2 A	1	1	1	1	7/30/92	Grazing
SS 113 2 B	1				8/7/92	Grazing
SS/BS 113 3 A	1	1	1	1	8/7/92	US-30
SS/BS 120 2 C	1	1	1	1	8/7/92	Grazing
SS/BS 125 3 A	1	1	1	1	8/6/92	Public Land
SS/BS 130 3 B	1		1		8/6/92	Public Land
SS/BS 135 2 A	1	1	1	1	7/29/92	Public Land
SS/BS 135 2 B	1		1		7/28/92	Public Land
SS/BS 135 2 C	1	1	1	1	7/28/92	Public Land
SS 135 3 A	1				8/9/92	Public Land
SS/BS 135 3 B	1	1	1	1	8/6/92	Public Land
SS/BS 158 2 B	1	1	1	1	7/28/92	Public Land
SS/BS 158 2 C	1		1		7/28/92	Public Land
SS 158 3 A	1				7/28/92	Public Land
SS/BS 158 3 B	1	1	1	1	7/29/92	Public Land
SS/BS 158 4 A	1		1		8/9/92	Public Land
SS 180 2 C	1				8/20/92	Public Land
SS/BS 180 3 A	1	1	1	1	8/10/92	Public Land
SS 180 3 B	1				8/10/92	Public Land
SS 180 4 A	1	1			8/9/92	Public Land
SS/BS 203 3 A	1	1	1	1	7/23/92	Not in use
SS/BS 203 3 B	1		1		7/23/92	Not in use
SS/BS 203 4 A	1	1	1	1	7/23/92	Agriculture
SS/BS 225 2 A	1	1	1	1	7/22/92	Not in use
SS/BS 225 2 B	1		1		7/22/92	Not in use
SS/BS 225 2 C	1	1	1	1	7/22/92	Not in use
SS/BS 225 3 A	1		1		7/22/92	Not in use
SS/BS 225 3 B	1	1	1	1	7/22/92	Not in use
SS/BS 248 3 B	1	1	1	1	8/1/92	Not in use
SS/BS 248 4 A	1		1		8/1/92	Pocatello Sod Farm/Residential
SS/BS 270 1 D	1	1	1	1	7/20/92	Racetrack
SS/BS 270 2 A	1		1		8/3/92	Canal
SS 270 2 B	1	1			10/23/92	Airport
SS 270 2 C	1	1			10/23/92	Airport
SS 270 3 A	1	1			10/23/92	Not known
SS/BS 270 3 B	1	1	1	1	10/23/92	Not known
SS/BS 293 1 A	1		1		7/20/92	Not in use
SS/BS 293 1 B	1		1		7/23/92	US-86
SS/BS 293 1 C	1		1		7/23/92	Agriculture

TABLE 2.2-1 *(continued)*
SURFACE SOIL SAMPLE SUMMARY

PHASE I

Phase I Sample ID	SS Chem	SS Rad	BS Chem	BS Rad	Date Sampled	Land Use
SS/BS 293 1 D	1	1	1	1	7/23/92	Agriculture
SS/BS 293 2 A	1		1		8/3/92	Agriculture
SS/BS 293 2 B	1		1		7/21/92	Not in use
SS/BS 293 2 C	1	1	1	1	7/21/92	Quarry
SS 293 3 A	1	1			10/23/92	Not known
SS/BS 293 3 B	1	1	1	1	10/23/92	Not known
SS/BS 315 1 A	1	1	1	1	7/20/92	Not in use
SS/BS 315 1 B	1		1		7/23/92	Agriculture
SS 315 1 C	1	1			7/27/92	Agriculture
SS/BS 315 1 D	1		1		7/27/92	Agriculture
SS/BS 315 2 A	1	1	1	1	8/4/92	Agriculture
SS 315 2 B	1				8/3/92	Agriculture
SS/BS 315 2 C	1	1	1	1	7/21/92	Not in use/Residential
SS/BS 315 3 A	1		1		7/21/92	Home on FHIR
SS/BS 315 3 B	1	1	1	1	7/21/92	Not in use
SS/BS 338 1 A	1		1		7/24/92	Not in use
SS/BS 338 1 B	1	1	1	1	7/24/92	Not in use
SS 338 1 C	1				7/30/92	Agriculture
SS/BS 338 1 D	1	1	1	1	7/27/92	Agriculture
SS/BS 338 2 A	1		1		8/3/92	Not in use
SS 338 2 B	1	1			8/3/92	Not in use
SS/BS 338 2 C	1	1	1	1	7/21/92	Not in use
SS/BS 338 3 A	1		1		7/21/92	Not in use
SS/BS 338 3 B	1		1		7/21/92	Not in use
Total	**108**	**59**	**84**	**47**		

TABLE 2.2-1 *(continued)*
SURFACE SOIL SAMPLE SUMMARY

PHASE II

Phase II Sample ID	SS Chem	SS Rad	BS Chem	BS Rad	Date Sampled	Land Use
SS/BS 045 1 A 1	1	1	1	1	6/24/93	US-86
SS/BS 045 1 A 2	1	1	1	1	6/24/93	Not in use
SS/BS 045 1 A 3	1	1	1	1	6/24/93	Not in use
SS/BS 045 1 A 4	1	1	1	1	6/30/93	Not in use
SS/BS 090 1 B 1	1	1	1	1	6/24/93	Ball field
SS/BS 090 1 B 2	1	1			6/24/93	US-30
SS/BS 090 1 B 3	1	1			6/24/93	US-30
SS/BS 090 1 B 4	1	1			6/25/93	EMF field trailer
SS/BS 090 1 B 5	1	1	1	1	6/27/93	Agriculture
SS/BS 090 1 C 5	1	1	1	1	6/27/93	Agriculture
SS/BS 205 3 A	1	1	1	1	7/7/93	FHIR fee land
SS/BS 205 3 B	1	1	1	1	7/7/93	FHIR fee land
SS/BS 205 4 A	1	1	1	1	7/22/93	FHIR fee land
SS/BS 230 3 A	1	1	1	1	7/7/93	Not in use
SS/BS 230 3 B	1	1	1	1	7/7/93	Private-Not in use
SS/BS 230 4 A	1	1	1	1	7/7/93	FHIR fee land
SS/BS 240 3 A	1	1	1	1	7/7/93	FHIR fee land
SS/BS 240 3 B	1	1	1	1	7/7/93	FHIR fee land
SS/BS 293 1 A 1	1	1	1	1	6/26/93	Not in use
SS/BS 293 1 A 2	1	1	1	1	6/25/93	Not in use
SS/BS 293 1 A 3	1	1	1	1	6/25/93	Not in use
SS/BS 293 1 A 4	1	1	1	1	6/26/93	Race track
SS/BS 293 1 B 1	1	1	1	1	6/26/93	US-86
SS/BS 293 1 B 3	1	1	1	1	6/26/93	Race track
SS/BS 293 1 B 4	1	1	1	1	6/26/93	US-86
SS/BS 293 1 B 5	1	1	1	1	6/27/93	FMC mail box
SS/BS 315 3 B 1	1	1	1	1	7/8/93	FHIR fee land
SS/BS 315 3 B 2	1	1	1	1	7/8/93	FHIR fee land
SS/BS 315 3 B 3	1	1	1	1	7/8/93	FHIR fee land
SS/BS 315 3 B 4	1	1	1	1	7/8/93	FHIR fee land
SS BKG D 0 1	1	1			7/23/93	I-15 and Center Street
SS BKG D 0 2	1	1			7/23/93	So. of State campus golf course
SS BKG D 0 3	1	1			7/23/93	Ross Park annex
SS BKG D 0 4	1	1			7/23/93	City of Pocatello
SS BKG D 0 5	1	1			7/23/93	Private - Not in use

Notes: 1 = Sample analyzed for suite of analytes indicated (i.e., chem or rad).
SS = Surface soil sample (0 to 2 inches).
BS = Below surface soil sample (2 to 2.5 feet).
Chem = Chemical analyses performed on sample.
Rad = Radiological analyses performed on sample.

TABLE 2.2-2
SOIL TYPES IN VICINITY OF THE EMF FACILITIES

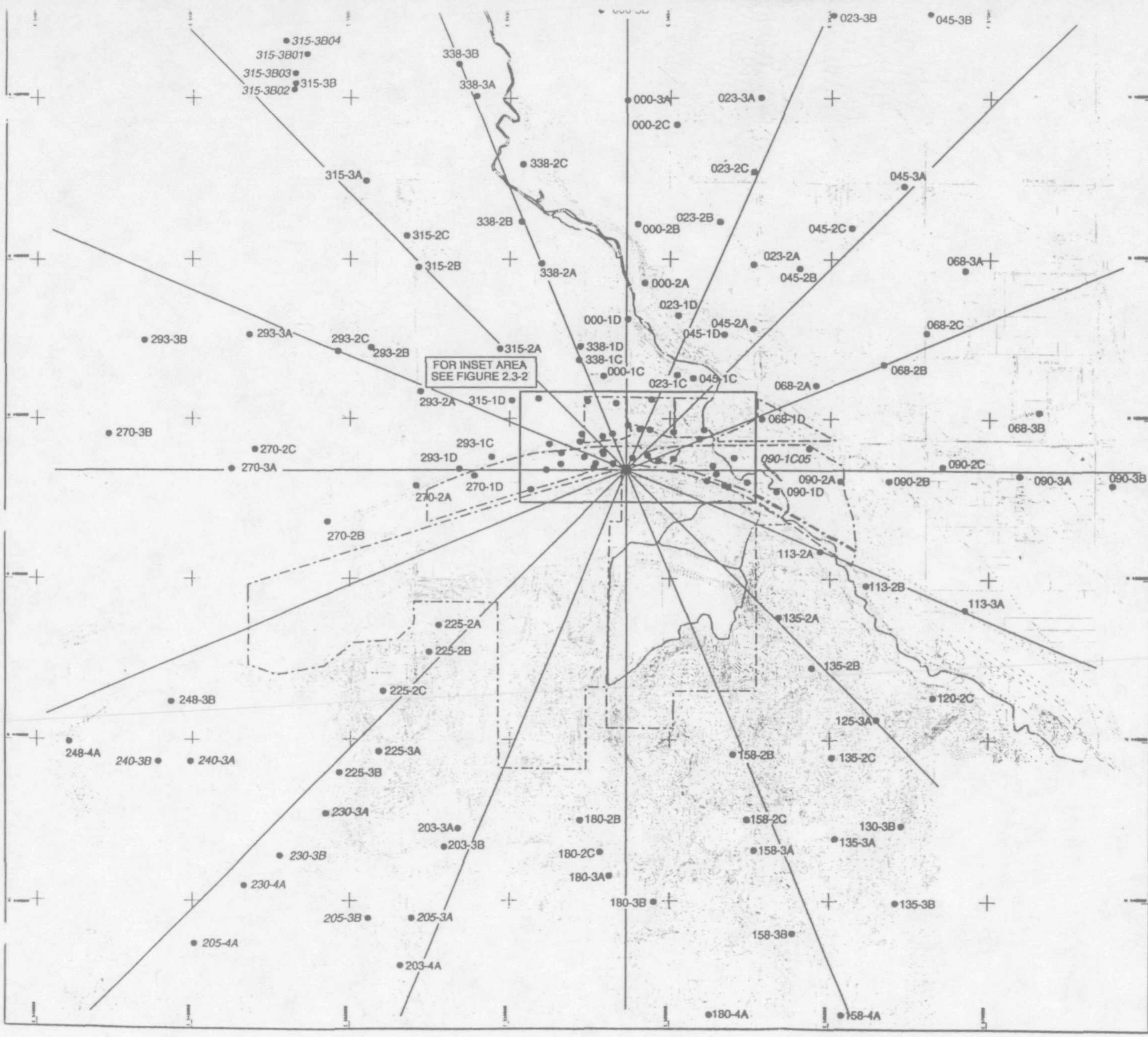
Fort Hall Area (a)	Bannock County Area (b)
Soils on Flood Plains and Low Terraces	
Snake-Philbon: Nearly level, deep and very deep silt loams and peats on bottom lands.	Inkom-Joesvar: Very deep, moderately well-drained, and well-drained soils that formed in silty alluvium.
Soils on Alluvial Terraces and Fans	
Paniogue-Declo: Nearly level to strongly sloping loamy coarse sands and sandy loams on alluvial fans and terraces. Paniogue-Broncho: Nearly level to moderately steep loams and gravely loams on alluvial fans and terraces.	Arimo-Downey-Bahem: Very deep, well-drained soils that formed in loess and silty alluvium overlying sand, gravel, cobbles, and stones.
Soils on High Terraces	
Pocatello-Wheeler-Portneuf: Nearly level to very steep silt loams on loess-mantled basalt plains and dissected low plateaus.	Ririe-Rexburg-Lanoak: Very deep, well-drained soils that formed in loess and in silty alluvium derived from loess.
Soils on Foothills and Mountains	
	Camelback-Hades-Valmar: Very deep to moderately deep, well-drained, noncalcareous soils that formed in alluvium, colluvium, and residuum derived from quartzite and related rocks.

Notes: (a) Source: SCS, 1977.
(b) Source: SCS, 1987.

TABLE 2.2-3
ANALYTICAL PARAMETERS FOR
SURFACE SOIL SAMPLES

I. Heavy Metals	**II. General Minerals**
Aluminum	Fluoride
Antimony	Phosphorus (total)
Arsenic	Phosphorus (orthophosphate)
Barium	Potasium[a]
Beryllium	Sulfate[a]
Boron	
Cadmium	**III. Radioactivity[b]**
Chromium	Gamma spectrometry[c]
Cobalt	Polonium-210
Copper	
Iron	**IV. Other**
Lead	pH
Lithium	
Manganese	
Mercury	
Molybdenum	
Nickel	
Selenium	
Silver	
Thallium	
Vanadium	
Zinc	

Notes: (a) Phase II samples only.
(b) Radiological analyses were performed on samples from every other sample location along each of the 16 transects.
(c) Includes identification of uranium-238 and lead-210.



Legend:

315-3B Phase I soil sample location and designation

315-3B01 Phase II soil sample location and designation

EMF Property Lines

N

0 3000 6000 FEET

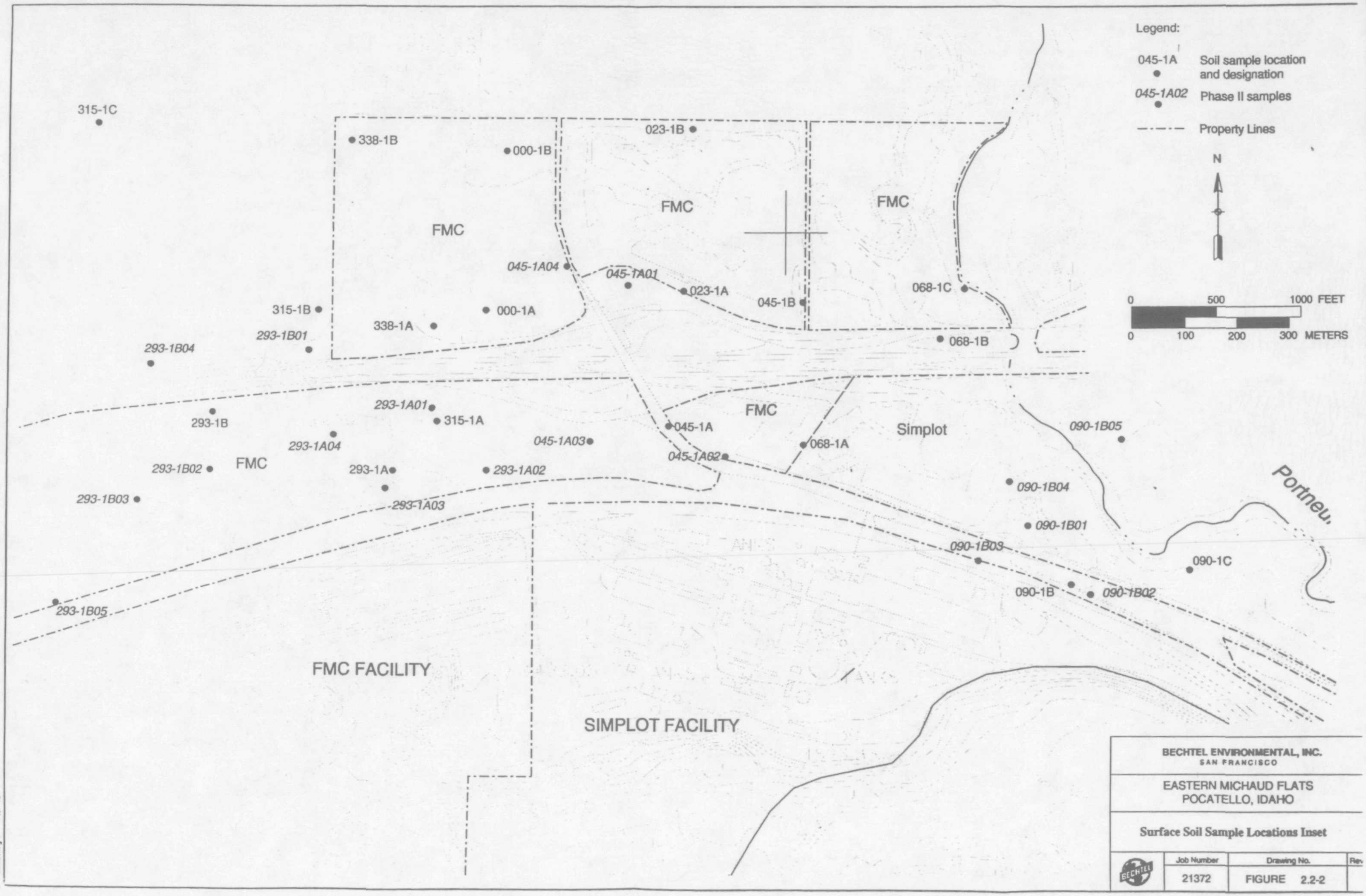
0 500 1000 1500 METERS

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Surface Soil Sample Locations

Job Number	Drawing No.	Rev.
21372	FIGURE 2.2-1	

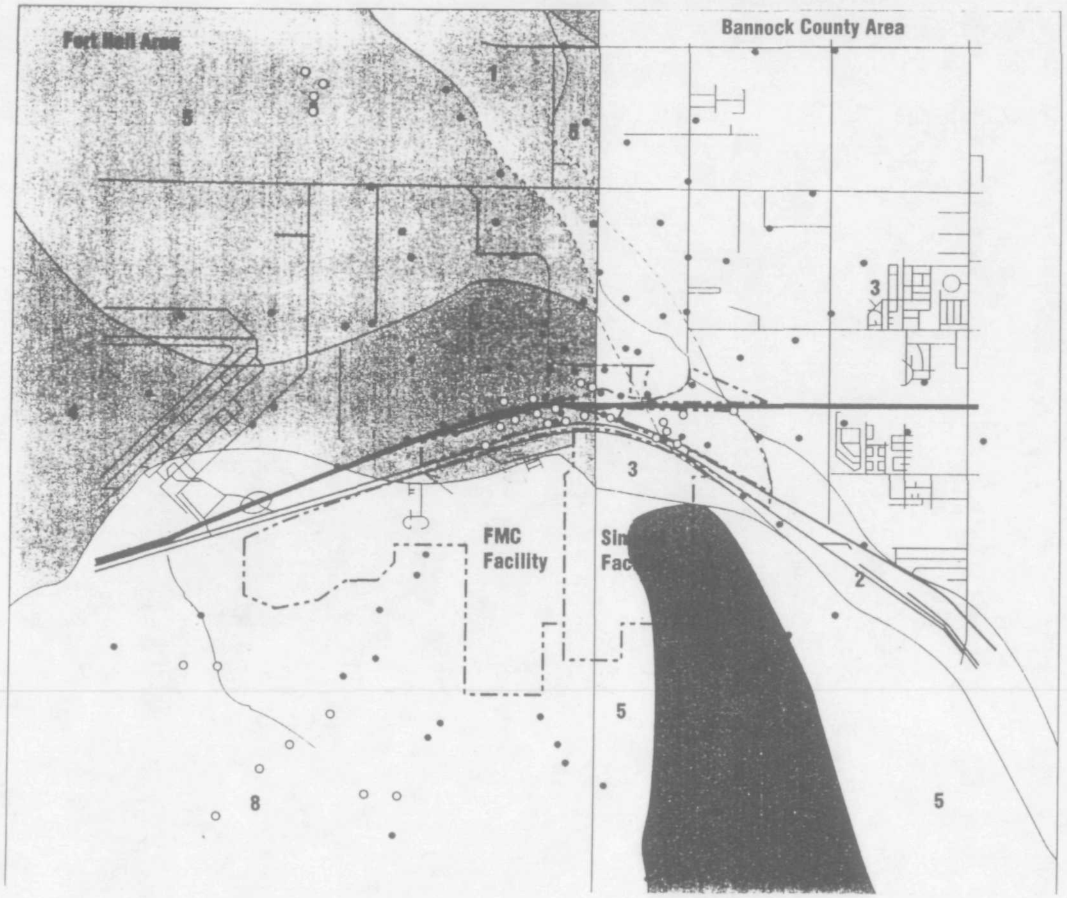


BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Surface Soil Sample Locations Inset

Job Number	Drawing No.	Rev
21372	FIGURE 2.2-2	



N

Legend:

- - - - - - Modified from original soils maps to provide continuity between associated soil types

— - - — EMF property lines

• Phase I sampling location

○ Phase II sampling location

Notes:

Numbers on soil associations correspond to original numbers on the soil surveys [illegible] soil surveys for Fort Hall Area [illegible] and Bannock County Area [illegible]

Scales

0 1 2 miles

0 1 2 3 kilometers

Soil Associations

Fort Hall Area

Nearly Level to Moderately Sloping Soils on Bottom Lands, Low Terraces, and Alluvial Fans

1 Snake Philbon association. Nearly level, deep and very deep silt loams and peats on bottom lands.

Nearly Level to Very Steep Soils on High Fans and Low Dissected Plateaus

Paniogue-Declo association. Nearly level to moderately sloping loams and silt loams on alluvial fans and terraces.

Paniogue-Broncho association. Nearly level to moderately steep loams and gravelly loams on alluvial fans and terraces.

8 Pocatello-Wheeler-Portneuf association. Nearly level to very steep silt loams on loess-mantled basalt plains and dissected low plateaus.

Bannock County Area

Soils on Flood Plains and Low Terraces

2 Inkom-Joevar. Very deep, moderately well drained and well drained soils that formed in silty alluvium.

Soils on High Terraces

3 Arimo-Downey-Bahem. Very deep, well drained soils that formed in loess and silty alluvium overlying alluvial sand, gravel, cobbles, and stones.

Soils on Fan Terraces and Foothills

5 Rine-Rexburg-Lanoak. Very deep, well drained soils that formed in loess and in silty alluvium derived from loess.

Soils on Foothills and Mountains

Camelback-Hades-Valmar. Very deep to moderately deep, well drained noncalcareous soils that formed in alluvium, colluvium, and residuum derived from quartzite and related rocks.

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Surface Soil Sampling Locations with Soil Types in EMF Study Area

BECHTEL | 21372 | FIGURE 2.2.3

2.3 HYDROGEOLOGIC AND GEOLOGIC SUBSURFACE INVESTIGATIONS

This section describes the various procedures used to collect field data and soil/rock samples, and other activities associated with hydrogeologic and geologic site characterization. The activities described occurred as part of Phase I, Phase II, and Phase III hydrogeologic and geologic subsurface investigations (Bechtel, 1992b; Bechtel, 1993c).

2.3.1 SUMMARY OF FIELD ACTIVITIES

During the Phase I, II, and III hydrogeologic investigations conducted in 1992, 1993, and 1994, the following field activities were performed:

- Drilling and logging of 83 borings
- Installation of 77 monitoring wells, one piezometer, and one nested piezometer
- Laboratory testing of 58 soil samples from 17 borings
- Slug testing in 63 wells
- Five aquifer pumping tests
- Downhole geophysical logging (gamma and temperature) in 34 wells
- Quarterly collection of groundwater samples from Phase I and selected pre-Phase I wells from April 1992 through April 1993
- Collection of groundwater samples from pre-Phase I, Phase I, and Phase II wells during the June, September, and December 1993 sampling events
- Grouting (plugging) and abandonment of seven existing wells. One well (Well 311) was abandoned and replaced with Well 329 due to high pH from grout contamination.
- Collection and analysis of groundwater samples from 12 wells for speciation of radiological isotopes during the March 1994 sampling event.
- Collection of groundwater samples from the reduced Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) monitoring network and Phase III three wells in June and December 1994. With EPA's concurrence, the reduced CERCLA groundwater monitoring program was implemented in 1994. The reduced CERCLA program was outlined in a proposal dated December 1993, and the revised proposal was

submitted to EPA in May 1994 detailing changes made in response to EPA's comments. As part of the revised sampling and analysis program, turbidity measurements were collected in the field during well purging.

Other field activities involving soil borings were performed concurrently with the hydrogeologic investigation. These activities included drilling and backfilling borings to collect soil samples for physical and chemical analyses, and installing a water production well.

2.3.2 Boring and Well Location Selection Process

Selection of boring and well locations was guided by the need to define subsurface stratigraphy and to monitor subsurface contaminant occurrence and migration. Since subsurface lateral migration occurs mainly within permeable zones below the water table, borings and wells were drilled and installed to:

- Define the vertical and lateral extent of saturated coarse-grained intervals
- Determine aquifer characteristics
- Monitor water quality and contaminant levels
- Obtain hydraulic head measurements

Figure 2.3-1 shows the locations of borings and wells drilled and installed in 1990, 1992, 1993, and 1994, and selected wells installed before 1990. The borings and wells are generally at the location specified in the SAP (Bechtel, 1992a), the RI/FS Work Plan (Bechtel, 1992b), and the Phase II Site Investigation Plan (Bechtel, 1993c). The borings and wells were numbered as follows:

- 139 through 154, 158 through 164 at the FMC facility [continuing the sequence 101 through 138 begun in 1990 by Bechtel (1991)]
- 300 through 335 at the Simplot facility (303 and 314 were not drilled)
- 500 through 525 for borings and wells beyond the main plant boundaries of the two facilities

Wells installed in these borings were assigned the same number as the boring number. Solitary wells were generally screened in the shallowest saturated coarse-grained interval. Well pairs were installed to screen one well in the shallowest saturated coarse-grained interval and the other well in a deeper saturated coarse-grained interval. Table 2.3-1 indicates which well numbers correspond to the shallow and which to the deeper wells of the well pair or cluster.

A tabulation of drilling and well completion data is provided in Appendix B. These data are summarized for the Phase I, Phase II, and Phase III wells; for older wells installed in 1990; for wells installed by PEI Associates in 1984 and Geraghty and Miller, Inc. in 1980 and 1981; and for FMC and Simplot production wells installed in the 1940s through the 1960s. Appendix B contains the geologic drill logs and well construction diagrams of all wells installed by Bechtel, from both the Phase I and II investigations and from the 1990 investigation for FMC.

2.3.3 Drilling Methods

The subsurface investigations utilized two drilling contractors: Layne Environmental, Inc., and Boyles Brothers Drilling Company. Layne Environmental, Inc. used a truck-mounted AP-1000 drill rig. This drill rig used a 9.75-inch outer-diameter (OD) and 6-inch inner-diameter (ID) dual-wall casing driven by a rig-mounted diesel-powered percussion hammer with reverse-air circulation. The drive pipe maintained an open hole in loose, unconsolidated materials and minimized both potential circulation loss and cross-contamination between water-bearing intervals.

To install 8-inch nominal-diameter test wells for aquifer pumping tests (Wells 152 and 322), two borings were drilled using triple-wall casing that consisted of the 9.75-inch OD dual-wall casing inside an 11.75-inch OD outer casing with a 12.4-inch OD bit casing. This method allows the dual-wall casing to be removed after reaching the desired depth, and allows a large-diameter well or rotary drill string to be lowered within a hole cased by the remaining outer "triple" wall. Where very hard rock was encountered, a truck-mounted TH-60 air-rotary downhole hammer drill rig was employed with either a 5.625-inch OD rotary bit (using the dual-wall casing as a conductor casing) or a 9.25-inch OD rotary bit (using the triple wall as a conductor casing).

Boyles Brothers Drilling Company used two truck-mounted Schramm T685DH reverse-air rotary drilling rigs. One rig was equipped for ODEX drilling, which consists of a special down-hole, air-powered hammer and bit, and 9-inch OD casing. Once below the bottom of the casing, the ODEX bit, upon rotation of the drill string, expands about an eccentric pivot to an effective diameter of 9.625 inches. The larger hole allows the casing to follow the advancing bit. Reversing the rotation of the drill string causes the ODEX bit to return to its smaller diameter, allowing the drill string to be retracted back into the casing.

The other drill rig was equipped with a conventional down-hole air-powered hammer and bit, and 9-inch OD casing, which was advanced with a rig-mounted, air-powered casing driver. The conventional drill bit was used to advance the boring several feet ahead of the casing, and then the bit was retracted back up into the casing. The casing was then advanced to the bottom of the hole, or deeper, using the rig-mounted air-powered hammer. Finally, the conventional drill bit drilled out the cuttings inside the casing before further advancing the boring.

Bechtel hydrogeologists performed geologic logging by observing drill cuttings which, with the reverse-air circulation drilling methods, were rapidly lifted and expelled out of a rig-mounted cyclone separator. A number of split-spoon soil samples were collected to augment the cuttings and/or for submittal for laboratory testing. The samplers were advanced with a 140-pound 30-inch drop hammer. Seventy soil samples were collected and submitted to geotechnical laboratories for determination of grain-size distribution and moisture content.

Boyles Brothers Drilling Company and Layne Environmental, Inc. used Mobile B-80 hollow-stem auger drilling rigs for shallower soil borings not intended for completion as monitoring wells. These borings were primarily drilled in conjunction with the potential source and onsite soil investigations, and to collect additional subsurface soil samples and lithologic information where needed.

The drillers used 8.5-inch OD hollow-stem augers. A split-spoon sampler was used down the hollow-stem of the augers to collect soil samples. The split-spoon sampler was advanced with a 140-lb 30-inch drop hammer, with blow counts recorded for every 6 inches of penetration. Refusal was defined as needing more than 50 blows to penetrate 6 inches of material. Sample recovery and depth intervals were also recorded on the boring logs.

After drilling and sampling were completed, all onsite borings, except for those drilled under asphalt paving at the Simplot facility, were backfilled with grout to ground surface. Borings under asphalt paving at Simplot were backfilled with grout to 5 feet to ground surface, and then backfilled with sand to the ground surface to minimize settlement. The decontamination of drilling and sampling equipment and the handling of cuttings and wastewater are described in Section 2.3.11.

A tabulation of drilling and well completion data is provided in Appendix B.

2.3.4 CONSTRUCTION

Borings were drilled, and monitoring or test wells were installed, in accordance with federal (EPA, 1986c and 1989b) and state (Idaho Department of Water Resources, 1989) requirements.

Monitoring wells were typically constructed with a 4-inch nominal-diameter, flush-jointed polyvinyl chloride (PVC) well casing and screen. Schedule 40 PVC well casing was usually used in the construction of wells that extended to depths of 150 feet or less; Schedule 80 well casing was used to construct wells that extended to depths greater than 150 feet. Well screens used in the construction of the monitoring wells were manufactured or machine cut with 0.020-inch transverse slots. The annulus of each well was packed with clean, well-sorted sand (10-20 sieve size) manufactured by Colorado Silica Sand, Inc. The filter pack was placed from the bottom of the open hole to a level at least 2 feet above the screen interval. A bentonite seal was placed on top of the filter pack interval, and the remaining annulus was backfilled with a cement-bentonite grout placed with a tremie pipe.

This well construction design was modified for those wells in which pumping tests were planned. Specifically, Wells 152 and 322 were constructed with 8-inch nominal-diameter PVC well casing with a 0.030-inch slotted well screen, surrounded by a coarse (4-16 sieve size) material for the filter pack. (Schedule 80 PVC casing was placed in Well 322.) In addition, the construction of Wells 144 and 312 differed only in the use of 6-inch rather than 4-inch PVC casing and screen; Schedule 80 PVC casing was used in Well 144.

Well construction diagrams of all wells installed during the Phase I, II, and III investigations are presented in Appendix B.

2.3.5 Well Development

During Phase I, both drilling contractors used designated crews to perform well development, accomplished by bailing, surging, airlifting, and/or pumping techniques. Well development was initiated and continued until field-measured parameters of temperature, pH, and electrical conductivity stabilized; the discharge water appeared to be clear and relatively free of sediment; or 10 well volumes were removed from the well. (The decontamination of well development equipment and the handling of well development water are described in Section 2.3.11.) During Phase II, similar methods were employed by Layne Environmental, Inc.; however, no airlifts were conducted.

2.3.6 Groundwater Sampling

Wells installed during the Phase I, Phase II, and Phase III investigations were developed, purged, and sampled. The first groundwater samples obtained from the Phase I monitoring wells were collected by Bechtel during April 1992; subsequently, these wells were placed on a quarterly groundwater sampling program along with existing groundwater monitoring wells. This quarterly sampling program was implemented by Hydrometrics, Inc., beginning in June 1992. Phase II monitoring wells were added as part of the regular quarterly groundwater sampling event in July 1993. Phase III wells were sampled during the June and December 1994 groundwater sampling events. Phase I and Phase II well development records and Bechtel sampling field notes are presented in Appendix C. Quarterly monitoring records prepared by Hydrometrics, Inc. and previously submitted to the EPA, include the field records for purging and sampling.

After Phase I well development, an initial sample of groundwater was collected from each well by a Bechtel representative and submitted for chemical analyses. In addition, five existing PEI wells at the Simplot facility were purged and sampled. The well sampling records for the initial round of sampling are included in Appendix C, which also incorporates well development data for the new wells. (In two instances, well development was completed on a day preceding well sampling, and the initial well sampling records lack well development data. Well development data are appended to these sampling records [Wells 309 and 310].) Phase II wells were added to the quarterly groundwater sampling program after all Phase II wells were installed. Phase III wells were sampled for two quarters in 1994.

The following subsections describe the sampling and decontamination procedures followed during groundwater sampling.

2.3.6.1 Groundwater Sampling Procedures

During the April 1992 sampling event, the wells were purged using a bailer, an electric submersible pump, or by air-lift apparatus, depending on the diameter and capacity of the well. Wells from which samples for volatile and semi-volatile organic analysis were collected were purged using methods other than airlifting. A minimum of three casing volumes was removed from each well. When a well was pumped dry during purging, it was pumped dry two times, allowing 80-percent water level recovery between purges and prior to sampling. During purging, indicator parameters (pH, conductivity, and temperature) were monitored to verify that the water to be sampled was representative of groundwater from the formation. Following purging, samples were collected using a stainless steel or PVC bailer, or a discharge port from the airlifting or pumping apparatus.

During the subsequent sampling events conducted by Hydrometrics, Inc., the wells were purged using an electric submersible pump. Well purging procedures followed by Hydrometrics, Inc. were similar to those followed during the April 1992 sampling event. Following purging, all samples except for volatile and semivolatile organic samples, were collected using a discharge port from the pumping apparatus. Volatile and semivolatile organic samples were collected using a stainless steel bailer.

Water supply wells (e.g., New Pilot House well) were purged for 5 minutes directly from the sample ports prior to sampling collection. Details of the sampling procedure followed at each well were entered in a field notebook. The following information was recorded at the time of sampling:

- Sampler's name
- Date and time of sample collection
- Well identification
- Depth to groundwater prior to sampling
- Weather conditions
- Purging method and equipment
- Purged volume and pumping rate
- Measurements of indicator parameters (e.g., temperature, electrical conductivity, pH)
- Water appearance and odor (if any)
- Field Eh measurements (1993 sampling events)
- Field turbidity measurements (June and December 1994 sampling events)

- Sampling method and equipment
- Sample number
- Volume and type of sample containers used
- Field treatment or preservatives

Groundwater samples were collected using the following procedures:

- Samples were transferred from a precleaned disposable, stainless steel, or PVC bailer, or pumping apparatus directly to the appropriate sample containers. The types of containers and volume of water to be collected and preservation methods for each analysis type, and packaging procedures for sample shipment are presented in the SAP (Bechtel, 1992a).
- Samples to be analyzed for volatile organics were collected using a stainless steel single or double-check valve bailer and/or a precleaned disposable bailer.
- Containers were labeled as described in the SAP (Bechtel, 1992a).
- Field notes were recorded in ink in appropriate log books. Corrections were initialed and dated.
- Chain-of-custody records were filled out as described in the SAP (Bechtel, 1992a).

Samples designated for metals and orthophosphate analyses were filtered in the field using a peristaltic pump. Groundwater samples were field-filtered using the following procedures:

- Samples were collected directly into or transferred from the bailer or pump to a precleaned, unpreserved glass or polyethylene sample container.
- The sample was then filtered using tygon, silicon, or other compatible tubing connected to a 0.45-micron disposable filter. The sample was filtered directly into a sample container with preservatives, or preservatives were added immediately afterwards.
- The type of container, volume of water to be collected, and preservation methods were the same for filtered and unfiltered samples that were analyzed for metals.
- Filters and tubing were discarded and replaced after each use.

2.3.6.2 Decontamination of Sampling and Measurement Equipment

Bailers, tubing, and cord used for collection of groundwater samples were cleaned at the start of each job and between each well by steam cleaning or with a nonphosphate detergent wash followed by a tap-water rinse and a final deionized water rinse.

Steel tapes, water-level indicators, transducers, and water quality meters (pH, temperature, specific conductivity) were rinsed in deionized water or cleaned in a nonphosphate detergent solution and rinsed with fresh tap water.

2.3.7 Chemical and Radiological Groundwater Analyses

Groundwater samples were analyzed for general water quality parameters, heavy metals, radium, gross alpha, and gross beta. Volatiles and semivolatiles were analyzed once during selected groundwater sampling events. Table 2.3-2 lists the specific groundwater analyses that were performed. MSAI in Salt Lake City, Utah, performed the chemical analyses, and GEL in Charleston, South Carolina, conducted the radiological analyses.

Table 2.3-3 lists the wells, sampling dates, sample IDs, and analytical results for those samples analyzed for dissolved metals. These data, as well as the results for samples analyzed for total metals, are presented in Appendix V of Part II of the RI Report. These data have been included in the periodic updates to the EMF sampling database submitted to EPA.

All analytical methods were performed in accordance with the SAP (Bechtel, 1992a) and the RI/FS Work Plan (Bechtel, 1992b).

2.3.8 Well Abandonment and Boring Backfill Methods

All borings greater than 10 feet in depth and not completed as monitoring or test wells, such as boring 302, were backfilled with cement-bentonite grout placed with a tremie pipe and sealed from the bottom of the hole to ground surface. Shallow borings (less than 5 feet deep) and the upper few feet of some deeper borings overlain by asphalt on the Simplot facility were backfilled with sand.

In the past few years, a number of wells at the EMF facilities have been abandoned. During the Phase I investigation, Wells 153, TW-3S, FMC-5, PEI-1 through PEI-3, and PEI-5 were abandoned; during Phase II, Well 311 was abandoned in accordance with Idaho Department of Water Resources (1989) regulations.

2.3.9 DOWN-HOLE GEOPHYSICAL LOGGING

Down-hole temperature and gamma logging was performed in 34 selected wells from June 9 through June 15, 1992.

Temperature logging was performed to determine the vertical temperature profiles in selected wells for two reasons. First, low-temperature geothermal waters (bottom hole temperatures of 85-212°F) are a regulated resource in the state of Idaho (Idaho Department of Water Resources, 1989). Second, geothermal waters frequently contain elevated concentrations of metals and could therefore be a natural source of constituents that may also be under consideration as potential source constituents.

Previous investigations have encountered elevated groundwater temperatures in wells in the EMF study area. Investigators have postulated both the FMC furnace building (Geraghty and Miller, Inc., 1982b) and natural upwelling of geothermal waters along fracture zones and permeable units (Morrison-Knudsen, 1989) as thermal sources.

The temperature logging was performed using a Mount Sopris Instrument Company Model 1000-C portable borehole logger and Model DLP Temperature Probe with a range of 0-30°C (32-86°F). Wells were selected to provide a general areal distribution across the EMF facilities and to investigate the impact of possible thermal sources such as the FMC furnace building. Where a choice existed among several wells in close proximity, the deepest well was selected.

Prior to temperature logging, a well was allowed to remain undisturbed for several days to permit the temperature of the water in the well to reach thermal equilibrium with the formation outside the well casing. Both thermal and gamma logs were run during the same logging session, but the temperature log was performed first, beginning at the ground surface and ending at the bottom of the well. This method allowed the instrument to record the temperature of the undisturbed water in the well.

During logging, the probe was lowered at an approximate rate of 15 feet per minute. The resulting temperature records consisted of a line trace on a chart paper. These records were later converted to a digital database from which the temperature logs in Appendix D were generated. The temperature profiles recorded above the water level are not considered useful and have been omitted from the logs.

Gamma logging was performed in the wells to determine vertical profiles of naturally occurring gamma radiation. Gamma logs can be a useful tool to augment drill logs for correlation purposes as well as to detect anomalously high radioactivity. The selection of wells to be logged for gamma was primarily determined by the temperature logging needs. For the reasons stated above, gamma logging was performed after temperature logging. The portable borehole logger was used with a Model G375/A Standard Combination Probe, which produced results expressed in counts per second (cps). During logging, the probe was raised at an approximate rate of 15 feet per minute. As with the temperature logs, the gamma log trace was converted to a digital database from which the logs in Appendix D were generated.

2.3.10 HYDROGEOLOGIC TESTING

This section describes the pumping tests, slug tests, and laboratory tests performed during the Phase I Phase II, and Phase III hydrogeologic testing. Slug tests were performed in 63 wells to estimate hydraulic conductivity of individual, saturated, coarse-grained intervals. Pumping tests were performed in four wells to provide data for calculation of the transmissivity, hydraulic conductivity, and storativity of separate, saturated, coarse-grained intervals and to assess the degree of hydraulic connection, both laterally and vertically, within the saturated materials.

2.3.10.1 Pumping Tests

Constant-discharge pumping tests were performed in four wells: 150, 312, 322, and FMC-6. Well 152 was originally to be used in the pump testing program, but was not used due to low well yields. This well could not sustain a 9 gallons per minute (gpm) flow rate during step-testing. Well 150 yielded 30 gpm with much less drawdown during the step-test; therefore, the constant-rate pumping test was performed in Well 150. Wells 150 and 312 are open to the shallowest, saturated, coarse-grained interval, and Wells 322 and FMC-6 are open to deeper, saturated, coarse-grained intervals. Well FMC-6 was installed as a production well and was constructed with a much longer screened interval than Well 322. The tests were performed by pumping water at a constant rate from a selected well for an extended period, and measuring the water-level response in that well and in nearby wells. In addition, Simplot's new production well, SWP-7, was tested by the well construction contractor upon completion. Water levels were measured in several Simplot monitoring wells during this test.

Each pumping test required several days of preparation to determine static groundwater levels and pumping rates for the test. For some wells, water levels and pumping rates measured during well development were sufficient for preparing the pumping test. Based on these data as well as the limitations (if any) of the well, the pump size and pumping rate were selected for a constant-discharge test. Constant-discharge tests ran for 18 to 24 hours, followed by a recovery monitoring period. Observation wells were selected within the vicinity of each pumping well. The pumping tests are described below.

Well 150. A pumping test was conducted in Well 150 for a 24-hour period between June 11-12, 1992. A constant-discharge rate of 40 gpm was obtained using a 3-horsepower (hp) submersible pump. Water levels were monitored in nearby observation Wells 120 and 152, using an In-Situ, Inc., Hermit Environmental Data Logger with three pressure transducers. A portable water-level indicator was used to monitor groundwater levels in secondary observation wells (103, 104, 116, 117, 118, 119, 130, 133, 134, 137, and 151). Water pumped from Well 150 was discharged into nearby Pond 8S. Following the pumping period, water levels were monitored for 6 hours during the recovery interval.

Well 312. A pumping test was conducted in Well 312 for a 24-hour period between October 17-18, 1992. A constant-discharge rate of 213 gpm was obtained using a 15-hp submersible pump. Water levels were monitored in Well 312 and nearby observation Well 311 using the data logger and pressure transducers. Water levels were monitored in two additional observation wells, 309 and 310, with a portable water-level indicator. Water pumped from Well 312 during testing was discharged into a conduit leading to Simplot's water treatment ponds. Following the pumping test, water levels were monitored for approximately 8 additional hours.

Well 322. A pumping test was conducted in Well 322 for an 18-hour period between June 23-24, 1992. A constant-discharge rate of 410 gpm was obtained using a 15-hp submersible pump. Water levels were monitored in nearby observation Wells 321, PEI-4, and PEI-6 using the data logger and pressure transducers. Water levels in observation Wells 506 and 507 were monitored with a portable water-level indicator. Water pumped from the well was discharged into a conduit leading to Simplot's water treatment ponds. The constant-discharge test was terminated after 18 hours of pumping when the water treatment ponds had filled to capacity. Following the pumping test, water levels were monitored for an additional 12 hours.

Well FMC-6. A pumping test was conducted in the new FMC production well (FMC-6) for a 24-hour period between July 29-30, 1992. A constant-discharge rate of 700 gpm was obtained using a submersible pump. Water levels were monitored in nearby Wells TW-2S and TW-2I using a portable water-level indicator. Following the pumping period, water levels were monitored for an additional 4 hours. Approximately 1 million gallons were removed from the well during the test and were discharged through a temporary FMC pipeline into an irrigation canal.

Well SWP-7. A pumping test was conducted in the new Simplot production well (SWP-7) between May 11 and 14, 1993. A step test was conducted on May 11, 1993, with flow rates varying from 1,500 to 3,000 gpm. After completion of the step-test and an adequate period for aquifer recovery, a constant-rate discharge test was performed using a constant flow rate of 3,100 gpm. Water levels were monitored in nearby Wells 324, 309, 310, 312, 325, 313, 315, 326, 311, 314, 320, 327, 317, and 503 using a portable water-level indicator.

2.3.10.2 Slug Tests

Slug tests were performed in both shallow and deeper, saturated, coarse-grained intervals across the EMF facilities. The majority of these tests were conducted in wells open to the shallowest, saturated, coarse-grained interval. Slug tests involved measuring the recovery time of the water level in a well following sudden displacement of the static water level. A slug was fabricated using a 6-foot-long section of Schedule 40 PVC pipe with an outer diameter of approximately 2.4 inches. The PVC pipe was filled with clean sand and distilled water, capped at both ends, and attached to a plastic-coated rope. Water-level displacement and recovery to static conditions were monitored using a Model 2000 Hermit Environmental Data Logger and pressure transducer manufactured by In-Situ, Inc.

Prior to each slug test, the static water level was measured using a portable water-level indicator. The pressure transducer was lowered into the well to a depth where it would remain underwater during the test. If the transducer itself caused a measurable change in water level, then the water level was allowed time to restabilize to a static level. Output from the transducer was monitored at the data logger and calibrated to the static waterlevel depth determined by the portable water-level indicator. The slug test was then performed by lowering the slug into the water as rapidly and smoothly as possible.

The slug displaced a known volume of water, and the changes in water levels were recorded by the data logger until a return to stable, static conditions was achieved. This portion of the test is known as the "falling head" phase. The slug was then withdrawn from the well as rapidly and smoothly as possible, and the water level was monitored for the "rising head" phase of the test until it returned to a stable, static condition. The pressure transducer was removed from the well at the completion of the slug test.

The rate at which the water level recovers from the sudden displacement, and the manner in which this rate varies over time, are controlled by the hydraulic characteristics of the formation in the immediate vicinity of the well screen. Methods of data analysis differ, depending on the degree of confinement of the aquifer and the response characteristics.

In March 1994, Hydrometrics, Inc. performed slug tests in 24 monitoring wells using similar methods. Their field methods, data analysis methods, and results are presented in Appendix F.

2.3.10.3 Laboratory Tests

Laboratory tests were performed on selected soil samples to identify physical and hydrogeologic parameters in vadose and saturated zones. Seventy soil samples were collected from 16 borings and analyzed for grain size distribution (ASTM D 4220-63) and moisture content (ASTM D 2216-80). Forty-nine of these samples were also analyzed for saturated hydraulic conductivity (ASTM D 2434-68). The soil samples were collected with split-spoon samplers fitted with brass sample tubes. Most of the samples were collected from the vadose zone.

2.3.11 Decontamination and Handling of Waste Materials

Drill rigs, well-development rigs, and associated drill bits, rods, casing, samplers, and other equipment were steam-cleaned upon arrival at the EMF facilities and after completion of work at each hole. Layne Environmental, Inc., set up a decontamination pad at the FMC facility near Well 114, and Boyles Brothers Drilling Company set up a decontamination pad between the upper and lower gypsum stacks at the Simplot facility. Soil sampling equipment was decontaminated between each use with a three-stage wash consisting first of a tap water and nonphosphate detergent wash, then a tap water rinse, and finally a rinse with deionized water.

All decontamination fluids were contained at the decontamination pads for disposal in designated industrial ponds at each facility. Drill cuttings were handled in a variety of ways. Soil cuttings expelled from the rig-mounted cyclone separators were collected in troughs, plastic-lined pits, front-end loaders, or drums, and were transported by front-end loader, dump truck, or in drums on a flatbed truck for disposal at a designated area at each facility. Water expelled with the soil cuttings was collected in tubs or plastic-lined pits and pumped into truck-mounted tanks for transport for disposal in industrial ponds at each facility. Well-development water was pumped into truck-mounted tanks for transport to designated ponds at each facility. Discharge fluids from aquifer testing were directed to designated disposal sites through hoses and pipelines.

Cuttings from the first 30 to 60 feet (9 to 18 m) in each boring drilled on the FMC facility received special handling due to the potential presence of elemental phosphorous. The drill cuttings were discharged from the cyclone separator directly into steel drums which were then sealed and transported to a designated temporary storage area within the FMC facility.

2.3.12 SURVEYING

Locations and elevations of the EMF borings and wells were surveyed either by Bithell Engineering, Inc. or by Simplot. The survey results are tabulated with those of older wells in the Boring Logs and Well Construction Diagrams in Appendix B. The location coordinates and elevations are shown on the individual geologic drill logs and well-construction diagrams. Elevations were surveyed to a hundredth of a foot, and coordinates to a tenth of a foot. For wells, the surveyed locations are measuring points at the top of each well casing for gauging groundwater depth. The measuring points are either permanent marks or notches cut into the plastic casing. For backfilled borings, the approximate center point at the ground surface was surveyed.

The location coordinates are in the Idaho State Coordinate System, in feet northing and easting, relative to the U.S. Coast & Geodetic Survey (USC&GS) Control Station McDougall-2, and updated to the North American Datum of 1983 (NAD83). Existing USGS topographic maps (USGS, 1974, 1984) display the Idaho State Coordinate System of NAD27, which is about 25 feet greater in northing and about 155,986 feet less in easting. Elevations are in feet above mean sea level relative to control station BM Y-96, based on the 1968 adjustment of the National Geodetic Vertical Datum of 1929 (NGVD29), the same as the USGS topographic maps.

2.3.13 WATER-LEVEL MONITORING

Water depths in each newly completed well were measured during development and sampling. Static water-level depths in all Phase I wells, and in selected wells constructed prior to 1992, were measured on June 26, 1992, and during subsequent quarterly groundwater sampling rounds. Depths to water were measured with a portable water-level indicator to the nearest ±0.01 foot from the gauging mark or notch cut at the top of the well casing.

Six monitoring wells (TW-3D, TW-5D,TW-11I, 108, 129, and 144) had been previously equipped with submersible pumps to allow for more efficient sampling. In some cases, these pumps masked the measuring mark at the top of casing which had to be estimated when taking water-level measurements at these wells. Water-level data for all these wells should therefore be considered approximate (within two- or three-tenths of a foot margin of error).

Surface and Subsurface Characterizations
Tables for Section 2.3

TABLE 2.3-1
WELL PAIR CLUSTERS SHOWING SHALLOW AND DEEP SCREEN DESIGNATIONS

Shallow Wells	Deep Wells
101	102
104	103
108	107
110	109
118	117
126	125
137	129 130
134	133
145	144
310	309
316	315
318	317
320	319
312	311[a] 329
331	330
335S[b]	335D[b]
501	500
505	504
507	506
509	508
511	510
513	512
503	519
522	521
525	524
TW-4S	TW-4D TW-4I
TW-5S	TW-5D TW-5I

Notes: [a] Abandoned
[b] Nested piezometers installed in Boring 335

TABLE 2.3-2
ANALYTICAL PARAMETERS FOR GROUNDWATER SAMPLES

I. Heavy Metals	**IV. Volatile Organics[a]**
Aluminum	Chloromethane
Antimony	Bromomethane
Arsenic	Vinyl chloride
Barium	Chloroethane
Beryllium	Methylene chloride
Boron	Acetone
Cadmium	Carbon disulfide
Chromium	1,1-dichloroethene
Cobalt	1,1-dichloroethane
Copper	Trans-1,2-dichloroethene
Iron	Chloroform
Lead	1,2-dichloroethane
Lithium	2-Butanone
Manganese	1,1,1-trichloroethane
Mercury	Carbon tetrachloride
Molybdenum	Vinyl acetate
Nickel	Bromodichloromethane
Selenium	1,2-dichloropropane
Silver	cis-1,3-dichloropropene
Thallium	Trichloroethene
Vanadium	Dibromochloromethane
Zinc	1,1,2-trichloroethane
	Benzene
II. General Water Quality Parameters	Trans-1,3-dichloropropene
Alkalinity (bicarbonate)	2-chloroethylvinylether
Alkalinity (carbonate)	Bromoform
Ammonia	4-methyl-2-pentanone
Calcium	2-hexanone
Chloride	Tetrachloroethene
Conductivity	1,1,2,2-tetrachloroethane
Fluoride	Tetrahydrofuran
Magnesium	Toluene
Nitrate	Chlorobenzene
pH	Ethylbenzene
Phosphorus (total)	Styrene
Phosphorus (orthophosphate)	Total xylenes
Potassium	
Sodium	**V. Semivolatile Organics[a]**
Sulfate	Phenol
Temperature	bis(2-chloro-ethyl)ether
Total Dissolved Solids	2-chlorophenol
	1,3-dichlorobenzene
III. Radionuclides	1,4-dichlorobenzene
Gross Alpha	benzyl alcohol
Gross Beta	1,2-dichlorobenzene
Radium - 226[a]	2-methylphenol
Radium - 228[a]	

TABLE 2.3-2 *(continued)*
ANALYTICAL PARAMETERS FOR GROUNDWATER SAMPLES

V. Semivolatile Organics (continued)	
bis(2-chloroisopropyl)ether	4,6-dinitro-2-methylphenol
4-methylphenol	N-Nitrosodiphenylamine
n-nitroso-dipropylamine	4-Bromophenyl phenyl ether
Hexachloroethane	Hexachlorobenzene
Nitrobenzene	Pentachlorophenol
Isophorone	Phenanthrene
2-nitrophenol	Anthracene
2,3-dimethylphenol	Di-n-butyl phthalate
Benzoic acid	Fluoranthene
bis(2-chloroethoxy)methane	Pyrene
2,4-dichlorophenol	Butyl benzyl phthalate
1,2,4-trichlorobenzene	3,3"-dichlorobenzidine
Naphthalene	Benzo(a)anthracene
4-chloroaniline	bis(2-ethylhexyl)phthalate
Hexachlorobutadiene	Chrysene
4-chloro-3-methylphenol	Di-n-octyl phthalate
2-methylnaphthalene	Benzo(b)fluoranthene
Hexachlorocyclopentadiene	Benzo(k)fluoranthene
2,4,6-trichlorophenol	Benzo(a)pyrene
2,4,5-trichlorophenol	Indeno(1,2,3-c,d)pyrene
2-chloronaphthalene	Dibenzo(a,h)anthracene
2-nitroaniline	Benzo(g,h,l)perylene
Dimethyl phthalate	(1-methylethyl)-Benzene
Acenaphthylene	
3-nitroaniline	
Acenaphthylene	
2,4-dinitrophenol	
4-nitrophenol	
Dibenzofuran	
2,4-dinitrotoluene	
2,6-dinitrotoluene	
Diethyl phthalate	
4-chlorophenyl phenyl ether	
Fluorene	
4-nitroaniline	

Notes: (a) Selected samples only

TABLE 2.3-3
GROUNDWATER SAMPLES ANALYZED FOR DISSOLVED METALS

STA_ID	SAMP_DATE	SAMP_ID	CHEM_NAME	CONC_DET	QUAL	UNITS	QUAL_VAL	QUAL_CODE
116	7/31/93	F308340	Aluminum, dissolved	0.023	UP	mg/l	UJ	7
116	7/31/93	F308340	Antimony, dissolved	0.045	UP	mg/l	U	
116	7/31/93	F308340	Arsenic, dissolved	0.06555	H	mg/l		
116	7/31/93	F308340	Barium, dissolved	0.10675	BP	mg/l		
116	7/31/93	F308340	Beryllium, dissolved	0.001	UP	mg/l	U	
116	7/31/93	F308340	Boron, dissolved	1.6793	P	mg/l		
116	7/31/93	F308340	Cadmium, dissolved	0.001	UWF	mg/l	UJ	8
116	7/31/93	F308340	Calcium, dissolved	174.77017	P	mg/l		
116	7/31/93	F308340	Chromium, dissolved	0.00172	BWF	mg/l		
116	7/31/93	F308340	Cobalt, dissolved	0.00617	BP	mg/l		
116	7/31/93	F308340	Copper, dissolved	0.004	UP	mg/l	U	
116	7/31/93	F308340	Iron, dissolved	0.069	UP	mg/l	U	
116	7/31/93	F308340	Lead, dissolved	0.001	UF	mg/l	U	
116	7/31/93	F308340	Lithium, dissolved	0.1728	P	mg/l		
116	7/31/93	F308340	Magnesium, dissolved	79.41112	P	mg/l		
116	7/31/93	F308340	Manganese, dissolved	0.20693	P	mg/l		
116	7/31/93	F308340	Mercury, dissolved	0.00006	UAV	mg/l	U	
116	7/31/93	F308340	Molybdenum, dissolved	0.013	UP	mg/l	U	
116	7/31/93	F308340	Nickel, dissolved	0.011	UP	mg/l	U	
116	7/31/93	F308340	Potassium, dissolved	157.49067	P	mg/l		
116	7/31/93	F308340	Selenium, dissolved	0.01037	H	mg/l		
116	7/31/93	F308340	Silver, dissolved	0.004	UP	mg/l	U	
116	7/31/93	F308340	Sodium, dissolved	303.03414	P	mg/l		
116	7/31/93	F308340	Thallium, dissolved	0.001	UF	mg/l	U	
116	7/31/93	F308340	Vanadium, dissolved	0.002	UP	mg/l	U	
116	7/31/93	F308340	Zinc, dissolved	0.00342	BP	mg/l	U	7
131	5/26/93	F306215	Aluminum, dissolved	0.028	UP	mg/l	U	
131	5/26/93	F306215	Antimony, dissolved	0.039	UP	mg/l	U	
131	5/26/93	F306215	Arsenic, dissolved	0.05049	H	mg/l		
131	5/26/93	F306215	Barium, dissolved	0.05769	BP	mg/l		
131	5/26/93	F306215	Beryllium, dissolved	0.001	UP	mg/l	U	
131	5/26/93	F306215	Boron, dissolved	2.32012	NP	mg/l	J	8
131	5/26/93	F306215	Cadmium, dissolved	0.001	UWF	mg/l	UJ	15
131	5/26/93	F306215	Calcium, dissolved	126.54679	P	mg/l		
131	5/26/93	F306215	Chromium, dissolved	0.001	UNF	mg/l	U	
131	5/26/93	F306215	Cobalt, dissolved	0.01918	BP	mg/l		
131	5/26/93	F306215	Copper, dissolved	0.004	UP	mg/l	U	
131	5/26/93	F306215	Iron, dissolved	0.12008	P	mg/l	U	6
131	5/26/93	F306215	Lead, dissolved	0.001	UF	mg/l	U	
131	5/26/93	F306215	Lithium, dissolved	0.0378	BP	mg/l		
131	5/26/93	F306215	Magnesium, dissolved	54.29921	P	mg/l		
131	5/26/93	F306215	Manganese, dissolved	0.33802	P	mg/l		
131	5/26/93	F306215	Mercury, dissolved	0.00023	BAV	mg/l	U	7
131	5/26/93	F306215	Molybdenum, dissolved	0.013	UP	mg/l	U	
131	5/26/93	F306215	Nickel, dissolved	0.012	UP	mg/l	U	
131	5/26/93	F306215	Potassium, dissolved	12.21223	P	mg/l		
131	5/26/93	F306215	Selenium, dissolved	0.001	UH	mg/l	U	
131	5/26/93	F306215	Silver, dissolved	0.003	UP	mg/l	U	
131	5/26/93	F306215	Sodium, dissolved	150.62905	P	mg/l		
131	5/26/93	F306215	Thallium, dissolved	0.001	UNF	mg/l	U	
131	5/26/93	F306215	Vanadium, dissolved	0.004	UP	mg/l	U	
131	5/26/93	F306215	Zinc, dissolved	0.00375	BP	mg/l	U	7

TABLE 2.3-3
GROUNDWATER SAMPLES ANALYZED FOR DISSOLVED METALS

STA_ID	SAMP_DATE	SAMP_ID	CHEM_NAME	CONC_DET	QUAL	UNITS	QUAL_VAL	QUAL_CODE
131	7/30/93	F308333	Aluminum, dissolved	0.023	UP	mg/l	U	
131	7/30/93	F308333	Antimony, dissolved	0.045	UP	mg/l	U	
131	7/30/93	F308333	Arsenic, dissolved	0.00247	BH	mg/l		
131	7/30/93	F308333	Barium, dissolved	0.055	BP	mg/l		
131	7/30/93	F308333	Beryllium, dissolved	0.001	UP	mg/l	U	
131	7/30/93	F308333	Boron, dissolved	2.28508	P	mg/l	J	8
131	7/30/93	F308333	Cadmium, dissolved	0.001	UF	mg/l	U	
131	7/30/93	F308333	Calcium, dissolved	114.35599	P	mg/l		
131	7/30/93	F308333	Chromium, dissolved	0.001	UF	mg/l	U	
131	7/30/93	F308333	Cobalt, dissolved	0.01995	BP	mg/l		
131	7/30/93	F308333	Copper, dissolved	0.004	UP	mg/l	U	
131	7/30/93	F308333	Iron, dissolved	0.069	UP	mg/l	U	
131	7/30/93	F308333	Lead, dissolved	0.001	UF	mg/l	U	
131	7/30/93	F308333	Lithium, dissolved	0.03995	BP	mg/l	U	7
131	7/30/93	F308333	Magnesium, dissolved	49.36944	P	mg/l		
131	7/30/93	F308333	Manganese, dissolved	0.31327	P	mg/l		
131	7/30/93	F308333	Mercury, dissolved	0.00016	BAV	mg/l		
131	7/30/93	F308333	Molybdenum, dissolved	0.013	UP	mg/l	U	
131	7/30/93	F308333	Nickel, dissolved	0.011	UP	mg/l	U	
131	7/30/93	F308333	Potassium, dissolved	11.55656	P	mg/l		
131	7/30/93	F308333	Selenium, dissolved	0.002	UH	mg/l	U	
131	7/30/93	F308333	Silver, dissolved	0.004	UP	mg/l	U	
131	7/30/93	F308333	Sodium, dissolved	143.56292	P	mg/l		
131	7/30/93	F308333	Thallium, dissolved	0.001	UF	mg/l	U	
131	7/30/93	F308333	Vanadium, dissolved	0.002	UP	mg/l	U	
131	7/30/93	F308333	Zinc, dissolved	0.00295	BP	mg/l	U	7
131	12/3/93	312131	Aluminum, dissolved	0.0222	UP	mg/l	U	
131	12/3/93	312131	Antimony, dissolved	0.0514	UP	mg/l	U	
131	12/3/93	312131	Arsenic, dissolved	0.05448	AS	mg/l		
131	12/3/93	312131	Barium, dissolved	0.05728	BP	mg/l		
131	12/3/93	312131	Beryllium, dissolved	0.0003	UP	mg/l	U	
131	12/3/93	312131	Boron, dissolved	2.16506	P	mg/l		
131	12/3/93	312131	Cadmium, dissolved	0.0001	UF	mg/l	U	
131	12/3/93	312131	Calcium, dissolved	117.9439	P	mg/l		
131	12/3/93	312131	Chromium, dissolved	0.00055	BWF	mg/l		
131	12/3/93	312131	Cobalt, dissolved	0.01868	BP	mg/l		
131	12/3/93	312131	Copper, dissolved	0.0034	UP	mg/l	U	
131	12/3/93	312131	Iron, dissolved	0.08212	BP	mg/l		
131	12/3/93	312131	Lead, dissolved	0.0005	UF	mg/l	U	
131	12/3/93	312131	Lithium, dissolved	0.04109	BP	mg/l	U	
131	12/3/93	312131	Magnesium, dissolved	50.42142	P	mg/l		
131	12/3/93	312131	Manganese, dissolved	0.43062	P	mg/l		
131	12/3/93	312131	Mercury, dissolved	0.0001	BAV	mg/l	U	
131	12/3/93	312131	Molybdenum, dissolved	0.00959	UP	mg/l	U	
131	12/3/93	312131	Nickel, dissolved	0.0138	UP	mg/l	U	
131	12/3/93	312131	Potassium, dissolved	11.25749	P	mg/l		
131	12/3/93	312131	Selenium, dissolved	0.00225	BAS	mg/l		
131	12/3/93	312131	Silver, dissolved	0.0038	UNP	mg/l	UJ	
131	12/3/93	312131	Sodium, dissolved	137.59165	P	mg/l		
131	12/3/93	312131	Thallium, dissolved	0.0007	UF	mg/l	UJ	
131	12/3/93	312131	Vanadium, dissolved	0.00316	BP	mg/l		
131	12/3/93	312131	Zinc, dissolved	0.0029	UP	mg/l	U	

TABLE 2.3-3
GROUNDWATER SAMPLES ANALYZED FOR DISSOLVED METALS

STA_ID	SAMP_DATE	SAMP_ID	CHEM_NAME	CONC_DET	QUAL	UNITS	QUAL_VAL	QUAL_CODE
131	3/11/94	403131	Aluminum, dissolved	0.02	UP	mg/L	U	
131	3/11/94	403131	Antimony, dissolved	0.0452	UP	mg/L	U	
131	3/11/94	403131	Arsenic, dissolved	0.04715	AS	mg/L		
131	3/11/94	403131	Barium, dissolved	0.05876	BP	mg/L		
131	3/11/94	403131	Beryllium, dissolved	0.0002	UP	mg/L	U	
131	3/11/94	403131	Boron, dissolved	2.27848	P	mg/L		
131	3/11/94	403131	Cadmium, dissolved	0.0001	UNF	mg/L	U	
131	3/11/94	403131	Calcium, dissolved	112.92675	P	mg/L		
131	3/11/94	403131	Chromium, dissolved	0.0007	UNF	mg/L	U	
131	3/11/94	403131	Cobalt, dissolved	0.01909	BP	mg/L		
131	3/11/94	403131	Copper, dissolved	0.0036	UP	mg/L	U	
131	3/11/94	403131	Iron, dissolved	0.38323	P	mg/L		
131	3/11/94	403131	Lead, dissolved	0.00059	UWNF	mg/L	U	
131	3/11/94	403131	Lithium, dissolved	0.03162	BP	mg/L	U	7
131	3/11/94	403131	Magnesium, dissolved	48.06214	P	mg/L		
131	3/11/94	403131	Manganese, dissolved	0.46849	P	mg/L		
131	3/11/94	403131	Mercury, dissolved	0.00014	BNAV	mg/L	UJ	6,8
131	3/11/94	403131	Molybdenum, dissolved	0.0133	UP	mg/L	U	
131	3/11/94	403131	Nickel, dissolved	0.0134	UP	mg/L	U	
131	3/11/94	403131	Potassium, dissolved	11.07307	P	mg/L		
131	3/11/94	403131	Selenium, dissolved	0.00512	AS	mg/L	U	7
131	3/11/94	403131	Silver, dissolved	0.0035	UP	mg/L	U	
131	3/11/94	403131	Sodium, dissolved	135.75123	P	mg/L		
131	3/11/94	403131	Thallium, dissolved	0.00072	BNF	mg/L	J	8
131	3/11/94	403131	Vanadium, dissolved	0.0021	UP	mg/L	U	
131	3/11/94	403131	Zinc, dissolved	0.0041	UP	mg/L	U	
131	6/25/94	406131A	Aluminum, dissolved	0.0243	UP	mg/l	U	
131	6/25/94	406131A	Antimony, dissolved	0.0483	UP	mg/l	U	
131	6/25/94	406131A	Arsenic, dissolved	0.04325	AS	mg/l		
131	6/25/94	406131A	Barium, dissolved	0.05758	BP	mg/l		
131	6/25/94	406131A	Beryllium, dissolved	0.0002	UP	mg/l	U	
131	6/25/94	406131A	Boron, dissolved	2.2469	P	mg/l		
131	6/25/94	406131A	Cadmium, dissolved	0.0001	BF	mg/l		
131	6/25/94	406131A	Calcium, dissolved	114.34	P	mg/l		
131	6/25/94	406131A	Chromium, dissolved	0.00025	BWF	mg/l	U	6
131	6/25/94	406131A	Cobalt, dissolved	0.01986	BP	mg/l		
131	6/25/94	406131A	Copper, dissolved	0.0031	UP	mg/l	U	
131	6/25/94	406131A	Iron, dissolved	0.0487	UP	mg/l	UJ	9
131	6/25/94	406131A	Lead, dissolved	0.0005	UF	mg/l	U	
131	6/25/94	406131A	Lithium, dissolved	0.03666	BP	mg/l		
131	6/25/94	406131A	Magnesium, dissolved	49.33947	P	mg/l		
131	6/25/94	406131A	Manganese, dissolved	0.42622	P	mg/l		
131	6/25/94	406131A	Mercury, dissolved	0.0001	UAV	mg/l	U	
131	6/25/94	406131A	Molybdenum, dissolved	0.0101	UP	mg/l	U	
131	6/25/94	406131A	Nickel, dissolved	0.0105	UP	mg/l	U	
131	6/25/94	406131A	Potassium, dissolved	11.5375	P	mg/l		
131	6/25/94	406131A	Selenium, dissolved	0.00672	AS	mg/l	U	7
131	6/25/94	406131A	Silver, dissolved	0.0041	UP	mg/l	U	
131	6/25/94	406131A	Sodium, dissolved	143.31727	P	mg/l		
131	6/25/94	406131A	Thallium, dissolved	0.0006	UNF	mg/l	UJ	8
131	6/25/94	406131A	Vanadium, dissolved	0.00352	BP	mg/l		
131	6/25/94	406131A	Zinc, dissolved	0.00915	BP	mg/l	U	7

TABLE 2.3-3
GROUNDWATER SAMPLES ANALYZED FOR DISSOLVED METALS

STA_ID	SAMP_DATE	SAMP_ID	CHEM_NAME	CONC_DET	QUAL	UNITS	QUAL_VAL	QUAL_CODE
131	9/8/94	409131	Aluminum, dissolved	1.1079	P	mg/l		
131	9/8/94	409131	Antimony, dissolved	0.0483	UP	mg/l	U	
131	9/8/94	409131	Arsenic, dissolved	0.05662	AS	mg/l		
131	9/8/94	409131	Barium, dissolved	0.08124	BP	mg/l		
131	9/8/94	409131	Beryllium, dissolved	0.0002	UP	mg/l	U	
131	9/8/94	409131	Boron, dissolved	2.18504	P	mg/l		
131	9/8/94	409131	Cadmium, dissolved	0.00039	BF	mg/l	U	7
131	9/8/94	409131	Calcium, dissolved	143.28216	P	mg/l		
131	9/8/94	409131	Chromium, dissolved	0.00133	BF	mg/l		
131	9/8/94	409131	Cobalt, dissolved	0.02239	BP	mg/l		
131	9/8/94	409131	Copper, dissolved	0.0031	UP	mg/l	U	
131	9/8/94	409131	Iron, dissolved	1.02006	P	mg/l		
131	9/8/94	409131	Lead, dissolved	0.00337	NF	mg/l	J	8
131	9/8/94	409131	Lithium, dissolved	0.04082	BP	mg/l	U	7
131	9/8/94	409131	Magnesium, dissolved	53.47916	EP	mg/l	J	16
131	9/8/94	409131	Manganese, dissolved	0.58115	P	mg/l		
131	9/8/94	409131	Mercury, dissolved	0.00058	AV	mg/l		
131	9/8/94	409131	Molybdenum, dissolved	0.0101	UP	mg/l	U	
131	9/8/94	409131	Nickel, dissolved	0.0105	UP	mg/l	U	
131	9/8/94	409131	Potassium, dissolved	11.68274	P	mg/l		
131	9/8/94	409131	Selenium, dissolved	0.0035	UAS	mg/l	U	
131	9/8/94	409131	Silver, dissolved	0.0041	UP	mg/l	U	
131	9/8/94	409131	Sodium, dissolved	140.2814	EP	mg/l	J	16
131	9/8/94	409131	Thallium, dissolved	0.0011	BF	mg/l	U	7
131	9/8/94	409131	Vanadium, dissolved	0.00491	BP	mg/l	U	7
131	9/8/94	409131	Zinc, dissolved	0.01065	BP	mg/l	U	7
131	12/2/94	412131	Aluminum, dissolved	0.0272	UP	mg/l	U	
131	12/2/94	412131	Antimony, dissolved	0.0522	UP	mg/l	U	
131	12/2/94	412131	Arsenic, dissolved	0.05741	AS	mg/l		
131	12/2/94	412131	Barium, dissolved	0.0553	BP	mg/l		
131	12/2/94	412131	Beryllium, dissolved	0.0002	UP	mg/l	U	
131	12/2/94	412131	Boron, dissolved	2.18634	P	mg/l		
131	12/2/94	412131	Cadmium, dissolved	0.0001	UF	mg/l	U	
131	12/2/94	412131	Calcium, dissolved	109.40605	P	mg/l		
131	12/2/94	412131	Chromium, dissolved	0.00095	BF	mg/l	U	7
131	12/2/94	412131	Cobalt, dissolved	0.01961	BP	mg/l		
131	12/2/94	412131	Copper, dissolved	0.0045	UNP	mg/l	UJ	8
131	12/2/94	412131	Iron, dissolved	0.1347	P	mg/l		
131	12/2/94	412131	Lead, dissolved	0.0005	UWF	mg/l	U	
131	12/2/94	412131	Lithium, dissolved	0.03755	BP	mg/l		
131	12/2/94	412131	Magnesium, dissolved	46.81935	P	mg/l		
131	12/2/94	412131	Manganese, dissolved	0.4995	P	mg/l		
131	12/2/94	412131	Mercury, dissolved	0.0001	UAV	mg/l	U	
131	12/2/94	412131	Molybdenum, dissolved	0.011	UP	mg/l	U	
131	12/2/94	412131	Nickel, dissolved	0.01218	BP	mg/l		
131	12/2/94	412131	Potassium, dissolved	10.56462	P	mg/l		
131	12/2/94	412131	Selenium, dissolved	0.0023	UAS	mg/l	U	
131	12/2/94	412131	Silver, dissolved	0.0038	UP	mg/l	U	
131	12/2/94	412131	Sodium, dissolved	125.95458	P	mg/l		
131	12/2/94	412131	Thallium, dissolved	0.0007	UF	mg/l	U	
131	12/2/94	412131	Vanadium, dissolved	0.0028	UP	mg/l	U	
131	12/2/94	412131	Zinc, dissolved	0.01308	BP	mg/l	U	7

TABLE 2.3-3
GROUNDWATER SAMPLES ANALYZED FOR DISSOLVED METALS

STA_ID	SAMP_DATE	SAMP_ID	CHEM_NAME	CONC_DET	QUAL	UNITS	QUAL_VAL	QUAL_CODE
144	8/2/93	F308363	Aluminum, dissolved	0.023	UP	mg/l	U	
144	8/2/93	F308363	Antimony, dissolved	0.045	UP	mg/l	U	
144	8/2/93	F308363	Arsenic, dissolved	0.00929	BH	mg/l	U	7
144	8/2/93	F308363	Barium, dissolved	0.06802	BP	mg/l		
144	8/2/93	F308363	Beryllium, dissolved	0.001	UP	mg/l	U	
144	8/2/93	F308363	Boron, dissolved	0.43801	P	mg/l		
144	8/2/93	F308363	Cadmium, dissolved	0.001	UWF	mg/l	U	
144	8/2/93	F308363	Calcium, dissolved	201.26716	P	mg/l		
144	8/2/93	F308363	Chromium, dissolved	0.00305	BF	mg/l		
144	8/2/93	F308363	Cobalt, dissolved	0.0138	BP	mg/l	U	7
144	8/2/93	F308363	Copper, dissolved	0.004	UP	mg/l	U	
144	8/2/93	F308363	Iron, dissolved	0.069	UP	mg/l	U	
144	8/2/93	F308363	Lead, dissolved	0.001	UF	mg/l	U	
144	8/2/93	F308363	Lithium, dissolved	0.07753	P	mg/l		
144	8/2/93	F308363	Magnesium, dissolved	64.76792	P	mg/l		
144	8/2/93	F308363	Manganese, dissolved	0.04015	P	mg/l		
144	8/2/93	F308363	Mercury, dissolved	0.00009	BAV	mg/l	U	6
144	8/2/93	F308363	Molybdenum, dissolved	0.013	UP	mg/l	U	
144	8/2/93	F308363	Nickel, dissolved	0.011	UP	mg/l	U	
144	8/2/93	F308363	Potassium, dissolved	15.55424	P	mg/l		
144	8/2/93	F308363	Selenium, dissolved	0.0095	H	mg/l		
144	8/2/93	F308363	Silver, dissolved	0.004	UP	mg/l	U	
144	8/2/93	F308363	Sodium, dissolved	82.62791	P	mg/l		
144	8/2/93	F308363	Thallium, dissolved	0.001	UWF	mg/l	U	
144	8/2/93	F308363	Vanadium, dissolved	0.002	UP	mg/l	U	
144	8/2/93	F308363	Zinc, dissolved	0.01466	BP	mg/l	U	7
158	7/31/93	F308341	Aluminum, dissolved	0.023	UP	mg/l	UJ	7
158	7/31/93	F308341	Antimony, dissolved	0.045	UP	mg/l	U	
158	7/31/93	F308341	Arsenic, dissolved	0.01735	H	mg/l		
158	7/31/93	F308341	Barium, dissolved	0.05812	BP	mg/l		
158	7/31/93	F308341	Beryllium, dissolved	0.001	UP	mg/l	U	
158	7/31/93	F308341	Boron, dissolved	0.0784	BP	mg/l		
158	7/31/93	F308341	Cadmium, dissolved	0.001	UWF	mg/l	UJ	8
158	7/31/93	F308341	Calcium, dissolved	49.81903	P	mg/l		
158	7/31/93	F308341	Chromium, dissolved	0.00317	BWF	mg/l		
158	7/31/93	F308341	Cobalt, dissolved	0.003	UP	mg/l	U	
158	7/31/93	F308341	Copper, dissolved	0.004	UP	mg/l	U	
158	7/31/93	F308341	Iron, dissolved	0.069	UP	mg/l	U	
158	7/31/93	F308341	Lead, dissolved	0.001	UF	mg/l	U	
158	7/31/93	F308341	Lithium, dissolved	0.01509	BP	mg/l	U	7
158	7/31/93	F308341	Magnesium, dissolved	19.67331	P	mg/l		
158	7/31/93	F308341	Manganese, dissolved	0.001	UP	mg/l	U	
158	7/31/93	F308341	Mercury, dissolved	0.00006	UAV	mg/l	U	
158	7/31/93	F308341	Molybdenum, dissolved	0.013	UP	mg/l	U	
158	7/31/93	F308341	Nickel, dissolved	0.011	UP	mg/l	U	
158	7/31/93	F308341	Potassium, dissolved	9.11928	P	mg/l		
158	7/31/93	F308341	Selenium, dissolved	0.002	UH	mg/l	U	
158	7/31/93	F308341	Silver, dissolved	0.004	UP	mg/l		
158	7/31/93	F308341	Sodium, dissolved	25.05286	P	mg/l	U	
158	7/31/93	F308341	Thallium, dissolved	0.001	UF	mg/l		
158	7/31/93	F308341	Vanadium, dissolved	0.004	BP	mg/l	U	
158	7/31/93	F308341	Zinc, dissolved	0.0024	BP	mg/l	U	

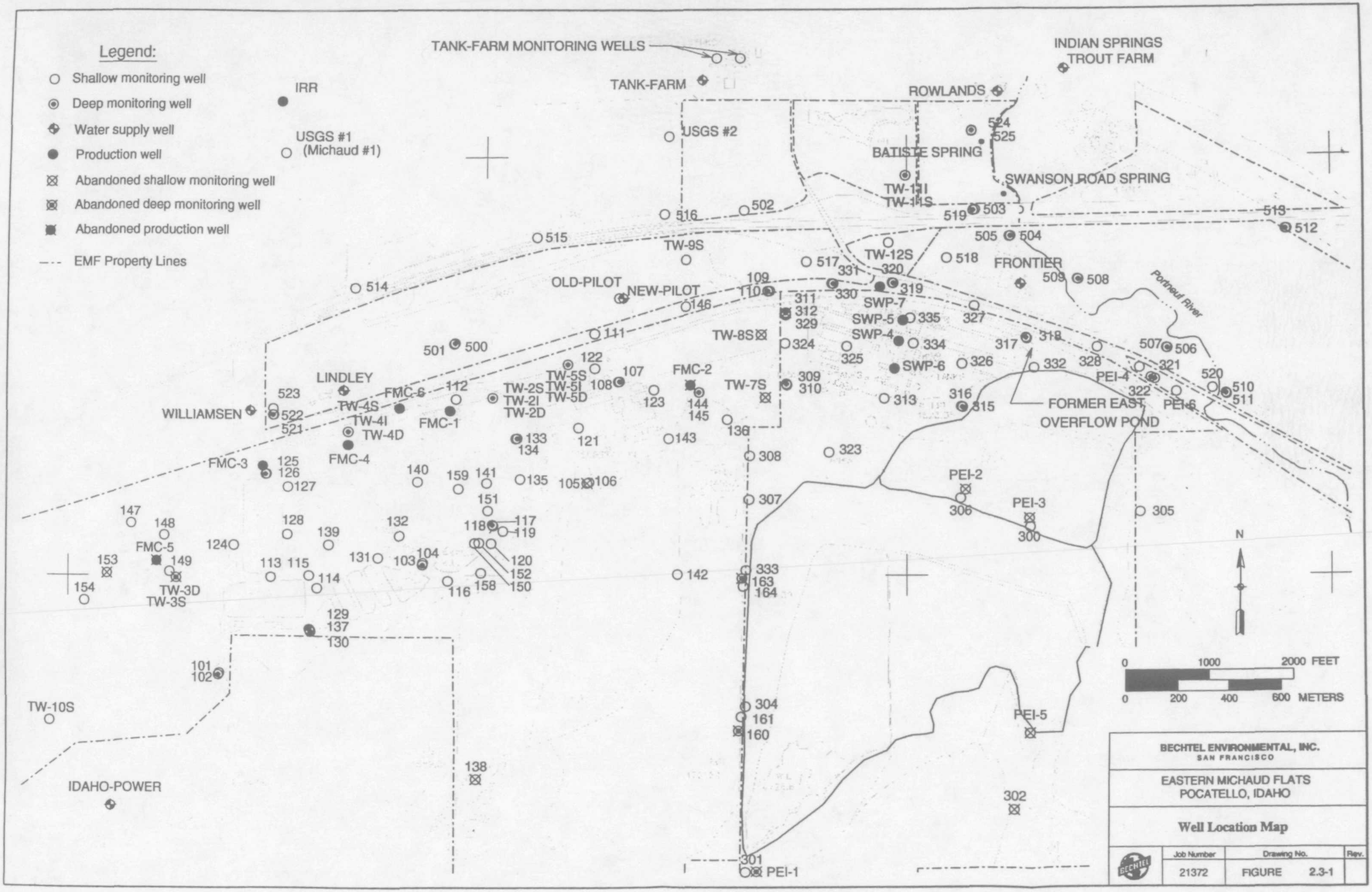
TABLE 2.3-3
GROUNDWATER SAMPLES ANALYZED FOR DISSOLVED METALS

STA_ID	SAMP_DATE	SAMP_ID	CHEM_NAME	CONC_DET	QUAL	UNITS	QUAL_VAL	QUAL_CODE
301	8/7/93	S308400	Aluminum, dissolved	0.023	UP	mg/l	U	
301	8/7/93	S308400	Antimony, dissolved	0.045	UP	mg/l	U	
301	8/7/93	S308400	Arsenic, dissolved	0.00453	BH	mg/l	U	6
301	8/7/93	S308400	Barium, dissolved	0.06136	BP	mg/l		
301	8/7/93	S308400	Beryllium, dissolved	0.001	UP	mg/l	U	
301	8/7/93	S308400	Boron, dissolved	0.03891	BP	mg/l	U	7
301	8/7/93	S308400	Cadmium, dissolved	0.001	UF	mg/l	U	
301	8/7/93	S308400	Calcium, dissolved	54.61044	P	mg/l		
301	8/7/93	S308400	Chromium, dissolved	0.00135	BF	mg/l		
301	8/7/93	S308400	Cobalt, dissolved	0.003	UP	mg/l	U	
301	8/7/93	S308400	Copper, dissolved	0.004	UP	mg/l	U	
301	8/7/93	S308400	Iron, dissolved	0.069	UP	mg/l	U	
301	8/7/93	S308400	Lead, dissolved	0.001	UF	mg/l	U	
301	8/7/93	S308400	Lithium, dissolved	0.00623	BP	mg/l	U	7
301	8/7/93	S308400	Magnesium, dissolved	13.92837	P	mg/l		
301	8/7/93	S308400	Manganese, dissolved	0.00151	BP	mg/l		
301	8/7/93	S308400	Mercury, dissolved	0.0001	BAV	mg/l	U	6
301	8/7/93	S308400	Molybdenum, dissolved	0.013	UP	mg/l	U	
301	8/7/93	S308400	Nickel, dissolved	0.0138	BP	mg/l	U	7
301	8/7/93	S308400	Potassium, dissolved	6.19538	P	mg/l		
301	8/7/93	S308400	Selenium, dissolved	0.002	UH	mg/l	U	
301	8/7/93	S308400	Silver, dissolved	0.004	UP	mg/l	U	
301	8/7/93	S308400	Sodium, dissolved	14.01181	P	mg/l		
301	8/7/93	S308400	Thallium, dissolved	0.001	UF	mg/l	U	
301	8/7/93	S308400	Vanadium, dissolved	0.002	UP	mg/l	U	7
301	8/7/93	S308400	Zinc, dissolved	0.00665	BP	mg/l		
325	8/9/93	S308425	Aluminum, dissolved	0.023	UP	mg/l	U	
325	8/9/93	S308425	Antimony, dissolved	0.045	UP	mg/l	U	
325	8/9/93	S308425	Arsenic, dissolved	0.08466	H	mg/l		
325	8/9/93	S308425	Barium, dissolved	0.06066	BP	mg/l		
325	8/9/93	S308425	Beryllium, dissolved	0.00112	BP	mg/l		
325	8/9/93	S308425	Boron, dissolved	0.35689	P	mg/l		
325	8/9/93	S308425	Cadmium, dissolved	0.001	UF	mg/l	U	
325	8/9/93	S308425	Calcium, dissolved	432.44567	P	mg/l		
325	8/9/93	S308425	Chromium, dissolved	0.00159	BF	mg/l		
325	8/9/93	S308425	Cobalt, dissolved	0.003	UP	mg/l	U	
325	8/9/93	S308425	Copper, dissolved	0.004	UP	mg/l	U	
325	8/9/93	S308425	Iron, dissolved	0.069	UP	mg/l	U	
325	8/9/93	S308425	Lead, dissolved	0.001	UWNF	mg/l	U	
325	8/9/93	S308425	Lithium, dissolved	0.14423	P	mg/l		
325	8/9/93	S308425	Magnesium, dissolved	127.10894	P	mg/l		
325	8/9/93	S308425	Manganese, dissolved	0.04882	P	mg/l		
325	8/9/93	S308425	Mercury, dissolved	0.00016	BAV	mg/l	U	6
325	8/9/93	S308425	Molybdenum, dissolved	0.013	UP	mg/l	U	
325	8/9/93	S308425	Nickel, dissolved	0.011	UP	mg/l	U	
325	8/9/93	S308425	Potassium, dissolved	32.18293	P	mg/l		
325	8/9/93	S308425	Selenium, dissolved	0.00313	BH	mg/l		
325	8/9/93	S308425	Silver, dissolved	0.004	UP	mg/l	U	
325	8/9/93	S308425	Sodium, dissolved	240.06343	P	mg/l		
325	8/9/93	S308425	Thallium, dissolved	0.001	UNF	mg/l	U	
325	8/9/93	S308425	Vanadium, dissolved	0.002	UP	mg/l	U	
325	8/9/93	S308425	Zinc, dissolved	0.01173	BP	mg/l	U	7

TABLE 2.3-3
GROUNDWATER SAMPLES ANALYZED FOR DISSOLVED METALS

STA_ID	SAMP_DATE	SAMP_ID	CHEM_NAME	CONC_DET	QUAL	UNITS	QUAL_VAL	QUAL_CODE
515	12/9/93	312515	Aluminum, dissolved	0.0222	UP	mg/l	U	
515	12/9/93	312515	Antimony, dissolved	0.0514	UP	mg/l	U	
515	12/9/93	312515	Arsenic, dissolved	0.00313	BAS	mg/l		
515	12/9/93	312515	Barium, dissolved	0.10837	BP	mg/l		
515	12/9/93	312515	Beryllium, dissolved	0.0003	UP	mg/l	U	
515	12/9/93	312515	Boron, dissolved	0.09666	BP	mg/l		
515	12/9/93	312515	Cadmium, dissolved	0.0001	UF	mg/l	U	
515	12/9/93	312515	Calcium, dissolved	92.48084	P	mg/l		
515	12/9/93	312515	Chromium, dissolved	0.00183	BSNF	mg/l	UJ	
515	12/9/93	312515	Cobalt, dissolved	0.0024	UP	mg/l	U	
515	12/9/93	312515	Copper, dissolved	0.0034	UP	mg/l	U	
515	12/9/93	312515	Iron, dissolved	0.0549	UP	mg/l	U	
515	12/9/93	312515	Lead, dissolved	0.0005	UNF	mg/l	U	
515	12/9/93	312515	Lithium, dissolved	0.05262	P	mg/l	U	
515	12/9/93	312515	Magnesium, dissolved	31.85354	P	mg/l		
515	12/9/93	312515	Manganese, dissolved	0.0008	UP	mg/l	U	
515	12/9/93	312515	Mercury, dissolved	0.0001	BAV	mg/l	U	
515	12/9/93	312515	Molybdenum, dissolved	0.00959	UP	mg/l	U	
515	12/9/93	312515	Nickel, dissolved	0.0138	UP	mg/l	U	
515	12/9/93	312515	Potassium, dissolved	8.4207	P	mg/l		
515	12/9/93	312515	Selenium, dissolved	0.00186	BNAS	mg/l	UJ	
515	12/9/93	312515	Silver, dissolved	0.0038	UP	mg/l	U	
515	12/9/93	312515	Sodium, dissolved	84.71567	P	mg/l		
515	12/9/93	312515	Thallium, dissolved	0.0007	UF	mg/l	U	
515	12/9/93	312515	Vanadium, dissolved	0.0024	UP	mg/l	U	
515	12/9/93	312515	Zinc, dissolved	0.0029	UP	mg/l	U	
TW-11I	6/25/94	406T11I	Aluminum, dissolved	0.0243	UP	mg/l	U	
TW-11I	6/25/94	406T11I	Antimony, dissolved	0.0483	UP	mg/l	U	
TW-11I	6/25/94	406T11I	Arsenic, dissolved	0.0031	UAS	mg/l	U	
TW-11I	6/25/94	406T11I	Barium, dissolved	0.05146	BP	mg/l		
TW-11I	6/25/94	406T11I	Beryllium, dissolved	0.0002	UP	mg/l	U	
TW-11I	6/25/94	406T11I	Boron, dissolved	0.07453	BP	mg/l		
TW-11I	6/25/94	406T11I	Cadmium, dissolved	0.0001	UF	mg/l	U	
TW-11I	6/25/94	406T11I	Calcium, dissolved	47.04992	P	mg/l		
TW-11I	6/25/94	406T11I	Chromium, dissolved	0.00075	BWF	mg/l		
TW-11I	6/25/94	406T11I	Cobalt, dissolved	0.0027	UP	mg/l	U	
TW-11I	6/25/94	406T11I	Copper, dissolved	0.0031	UP	mg/l	U	
TW-11I	6/25/94	406T11I	Iron, dissolved	0.0487	UP	mg/l	UJ	9
TW-11I	6/25/94	406T11I	Lead, dissolved	0.0005	UF	mg/l	U	
TW-11I	6/25/94	406T11I	Lithium, dissolved	0.03774	BP	mg/l		
TW-11I	6/25/94	406T11I	Magnesium, dissolved	15.79349	P	mg/l		
TW-11I	6/25/94	406T11I	Manganese, dissolved	0.00615	BP	mg/l	U	7
TW-11I	6/25/94	406T11I	Mercury, dissolved	0.0001	UAV	mg/l	U	
TW-11I	6/25/94	406T11I	Molybdenum, dissolved	0.0101	UP	mg/l	U	
TW-11I	6/25/94	406T11I	Nickel, dissolved	0.0105	UP	mg/l	U	
TW-11I	6/25/94	406T11I	Potassium, dissolved	4.53092	BP	mg/l		
TW-11I	6/25/94	406T11I	Selenium, dissolved	0.0035	UAS	mg/l	U	
TW-11I	6/25/94	406T11I	Silver, dissolved	0.0041	UP	mg/l	U	
TW-11I	6/25/94	406T11I	Sodium, dissolved	29.36265	P	mg/l		
TW-11I	6/25/94	406T11I	Thallium, dissolved	0.0006	UNF	mg/l	UJ	8
TW-11I	6/25/94	406T11I	Vanadium, dissolved	0.0023	UP	mg/l	U	
TW-11I	6/25/94	406T11I	Zinc, dissolved	0.00458	BP	mg/l	U	7

Surface and Subsurface Characterizations
Figures for Section 2.3



Legend:
Shallow monitoring well
Deep monitoring well
Water supply well
Production well
Abandoned shallow monitoring well
Abandoned deep monitoring well
Abandoned production well
EMF Property Lines
TANK-FARM MONITORING WELLS
TANK-FARM
INDIAN SPRINGS TROUT FARM
ROWLANDS
IRR
USGS #1 (Michaud #1)
USGS #2
BATISTE SPRING
SWANSON ROAD SPRING
TW-11I
TW-11S
524
525
519
503
502
516
515
513
512
505
504
TW-9S
TW-12S
517
518
FRONTIER
331
320
319
330
509
508
Portneuf River
OLD-PILOT
NEW-PILOT
109
110
146
311
312
329
SWP-7
SWP-5
335
327
514
SWP-4
334
TW-8S
324
325
317
318
111
501
500
122
TW-5S
TW-5I
TW-5D
107
108
FMC-2
144
145
TW-7S
309
310
313
SWP-6
326
332
328
507
506
321
PEI-4
322
520
510
511
PEI-6
316
315
FORMER EAST OVERFLOW POND
LINDLEY
FMC-6
112
TW-2S
TW-2I
TW-2D
123
523
522
521
WILLIAMSEN
TW-4S
TW-4I
TW-4D
FMC-1
FMC-4
133
134
121
143
136
308
323
FMC-3
125
126
127
140
159
141
135
105
106
PEI-2
306
307
151
118
117
119
PEI-3
300
305
147
148
FMC-5
149
124
128
139
132
153
154
TW-3D
TW-3S
113
115
114
131
103
104
116
158
120
152
150
142
333
163
164
129
137
130
101
102
TW-10S
304
161
160
PEI-5
138
IDAHO-POWER
302
301
PEI-1
N
0 1000 2000 FEET
0 200 400 600 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Well Location Map
Job Number
21372
Drawing No.
FIGURE 2.3-1
Rev.

2.4 SURFACE WATER AND SEDIMENT INVESTIGATION

A surface water and sediment investigation was conducted to identify the potential effects of EMF activities on the Portneuf River. Segments of the Portneuf River and associated springs and ponds were sampled to identify differences in water quality along the river. Section 2.4.1 discusses data collection activities related to surface water investigation, while the sediment investigation is addressed in Section 2.4.2.

The surface water and sediment sample locations are listed in Table 2.4-1. Locations where samples were collected during July 1992 are shown in Figure 2.4-1. Subsequent surface water samples were collected at 24 locations when weather and river conditions permitted. The samples were collected quarterly from July 1992 through April 1993. Supplementary sediment samples were collected during December 1992. In addition, surface water and sediment samples were collected during the Phase II field activities in July 1993 and the Phase III activities in June 1994. Phase III samples were analyzed for mercury only. Collection of additional sediment samples from the area of the IWW ditch outfall and the Portneuf River delta is described in Section 2.7.

Concurrent with the sampling of surface water, Portneuf River flow rates were measured at five of the sampling locations when weather and river conditions permitted. These locations are identified in Table 2.4-1. Flow rates were measured during each of the four rounds of surface water sampling. Flow rates were measured to develop a waterflow budget for the river so that flow contributions from springs and streams along the river could be estimated.

2.4.1 SURFACE WATER INVESTIGATION

The surface water sampling investigation was designed to provide information to evaluate the potential impacts of chemical loading to the water quality of the Portneuf River as a result of anthropogenic activities.

2.4.1.1 Sampling Locations Selection Process

The specific surface water sample locations were selected to provide:

- Samples upstream and downstream of the EMF facilities
- Samples at seeps and springs that discharge to the Portneuf River
- Samples below outfalls or other anthropogenic discharges to the Portneuf River watershed

Two sets of sample locations specified in the RI/FS Work Plan (Bechtel, 1992b) were eliminated. The first, consisting of springs believed to be in the proximity of the Rowland creamery, was eliminated because the springs could not be located. The second set, consisting of the "old Simplot discharge" and the "old FMC discharge" points, was eliminated because they were determined to be the same as sediment sampling location 18 (Figure 2.4-1).

Surface water samples were taken in areas representative of the flowing river or springs. Samples were generally not taken in stagnant water unless the water was representative of overall stream conditions at that sampling location.

During Phase I, elevated levels of some constituents were observed in sediment samples in the vicinity of the IWW ditch outfall to the Portneuf River. The location of this outfall is location 17 in Figure 2.4-1. It appeared from the physical description of the sediment obtained from this location that slag from the FMC facility was present in the sample. To evaluate this possibility, additional surface water and sediment samples were collected during Phase II (July 1993) field activities in the vicinity of the outfall. Surface water samples were collected in a profile across the river at location 17. For this profile, samples were collected at seven locations across the channel, both at depth within the river channel and just below the water surface.

2.4.1.2 Sampling and Analysis Procedures

This section describes the documentation, sampling, and decontamination procedures followed during the surface water sampling investigation.

Field Quality Control and Documentation

At a minimum, two sets of duplicates, matrix spike duplicates, and rinsates were collected for each quarterly round of surface water sampling. Each quarterly round of surface water sampling was scheduled for sampling at a minimum of 24 locations. Four additional surface water sampling locations were sampled in April 1993. In some cases, specific locations were deleted because of weather and river conditions.

The surface water sampling investigation adhered to the SAP (Bechtel, 1992a). Field sampling personnel maintained field log books that contained the following information for each sample:

- Sample identification number
- Sample collection date and approximate time
- Sample location description or location sketch
- Sample matrix
- Sample location and depth
- Sample appearance
- Type of sampling equipment used
- Sampler's name
- Chain-of-custody number

A label was affixed to each individual sample collected and included the following information:

- Project name and location
- Project number
- Date

- Time
- Sampler's initials
- Sample identification number
- Analysis required and sample preservative used

All sample locations were indicated on a sample location map. To help identify the sampling area, a minimum of one orange fiberglass survey marker labeled with the sample identification number was installed at each location.

Surface Water Sampling

All surface water samples were collected in a manner that minimized the amount of sediment in the sample. During the first and second quarters of sampling, grab samples were collected by direct submergence of the sampling bottles, with the exception of those samples that required filtering or a sample preservative. Samples requiring filtering were collected in a clean sample jar and then filtered into the appropriate container, usually within 1 hour of the time of collection. Samples requiring preservatives were collected in a clean sample jar and then emptied into a sample container containing a preservative. In order to split samples with the EPA during the third quarter event, samples were collected in decontaminated plastic buckets and then transferred to the appropriate sample bottles. Third quarter samples requiring filtering were then filtered through a 0.45 micron filter into the appropriate container. During the fourth quarter event, samples requiring filtering were collected in decontaminated plastic buckets and then immediately filtered through a 0.45 micron filter into the appropriate container.

Dissolved oxygen, electrical conductivity, pH, and temperature were determined in the field. The results of these field measurements are summarized in Table 2.4-2 for Phase I and Phase II.

Surface water sampling was conducted in accordance with the RI/FS Work Plan and the SAP (Bechtel 1992a and 1992b) except as follows:

- February 1993 – Surface Water Sampling
  - Unfiltered samples were collected using a decontaminated plastic bucket and then transferred to sample containers. Samples requiring filtering were then filtered through a 0.45 micron filter into the appropriate container.
  - Because of extremely cold weather conditions during the sampling event, the phosphate-free detergent rinse and deionized water rinse were eliminated from the decontamination procedure.
  - The stream gauging station at surface water sampling location 25 was not accessible because of snow and ice.
- April 1993 – Surface Water Sampling
  - Four additional surface water sampling locations were added.
  - Samples requiring filtering were collected in decontaminated plastic buckets and then immediately filtered through a 0.45 micron filter into the appropriate container.

Decontamination of Sampling and Measurement Equipment

The samples were collected directly into the sample containers. Third-quarter samples were collected in plastic buckets due to heavy snow/icy conditions that prevented easy access. Samples which required filtering or a sample preservative were also collected in decontaminated buckets. For those items requiring filtering or preservation, samples were placed in a collection jar or bucket, then filtered or transferred to the appropriate container. These containers were decontaminated by rinsing with a solution of deionized water and phosphate-free detergent, thoroughly rinsing with deionized water, and then thoroughly rinsing with river water at the next sample location.

Dissolved oxygen meters, pH meters, and electrical conductivity meters were decontaminated by thoroughly rinsing with deionized water.

Chemical and Radiological Analyses of Surface Water Samples

Surface water samples collected were analyzed for trace metals, standard water quality parameters, orthophosphate, total phosphorus, and radiological parameters, as indicated in Table 2.4-3. Both filtered (dissolved) and unfiltered (total) surface water samples were analyzed for heavy metals. MSAI in Salt Lake City, Utah, performed the chemical analyses. GEL in Charleston, South Carolina, conducted the radiological analyses.

All analytical methods were performed in accordance with the RI/FS Work Plan and the SAP (Bechtel, 1992a and 1992b).

2.4.1.3 Stream Gauging Procedures

At each stream gauging point, a cross section was established, and river depth and velocity were then measured at points across the width of the river. These points were spaced approximately 1 to 4 feet apart. Total river flow was then calculated by summing flow through each of the subsections. This procedure was employed at the sampling locations 01, 03, 10, 11,12E, 14, 16, 20, 22, and 25, weather and river conditions permitting.

Channel cross sections for stream gauging were chosen on the basis of their stable geometries, lack of inlets or outlets in the immediate vicinity of measurements, and for the uniform flow over a range of water depths. Actual measurements were conducted using the following procedure:

- At each designated cross-section, a surveyor's tape was set or held on the stake at either bank.
- The measurements were taken by proceeding across the river width with the tape and the current meter, moving along a line normal to the flow.
- The channel depth and distance from the stake were recorded every 1 to 4 feet of width.
- At these same points, one (or two if the section was greater than approximately 3 feet deep) flow velocity measurement was taken according to the following procedure:
  — The current meter was mounted on a vertical rod and directed into the river flow.

— Care was taken not to interfere with flow through current meter.

— If one measurement was made, the velocity was recorded at a point 0.6 x (total river depth below the water surface).

— If two measurements were made, velocities were recorded at 0.2 and 0.8 x (total river depth below the water surface).

Total flow through each cross-section was derived using the following calculations:

1. The average velocity at each point across the channel width is equal to the velocity measured at 0.6 x (total river depth below the water surface) or the average of the velocities at 0.2 and 0.8 x (total river depth below the water surface).

2a. The partial area associated with each average velocity comprises a rectangle extending horizontally from half the distance from the preceding depth location to half the distance to the next depth location, and vertically from the water level to the measured depth.

Example 1: Three depths of 0.6, 1.3, and 2.4 ft were measured at locations 4.0, 6.5, and 9.0 ft from the on-bank stake marking the cross section. The partial area for the second location 6.5 ft from the stake is 3.25 ft^2: 1.3 ft depth x [1/2 *(6.5 ft - 4.0 ft) + 1/2*(9.0 ft - 6.5 ft)]

2b. The partial area associated with depth measurements adjacent to each bank is the depth multiplied by half the distance to the next depth location plus the area between the bank and the measuring point.

Example 2: Utilizing the points of example 1, the partial area associated with the first reading (4.0 ft from the stake) is 3.15 ft^2: 0.6 ft depth x {(1/2 x (6.5 ft -4.0 ft) + 4.0 ft}.

3. The partial flow at each measurement location is the product of the average velocity and its associated partial area.

Example 3: If the three points listed in example 1 had average velocities of 0.1, 0.9, and 1.5 ft/sec respectively, the partial flows for the first two sections are approximately 0.32 ft^3/sec (0.1 ft/sec x 3.15 ft^2) and 2.93 ft^3/sec (0.9 ft/sec x 3.25 ft^2).

4. All of the calculated partial flows through the cross section were summed to obtain the total flow.

2.4.2 SEDIMENT INVESTIGATION

This section describes the rationale used to select the sediment sampling locations and their relationship to the surface water sampling locations.

2.4.2.1 Sampling Locations Selection Process

Sediment sampling locations were selected in the vicinity of the surface water sampling locations to aid in evaluating stream loading. An exception to this rationale was the additional sediment sampling which took place from November to December 1992. Two locations, A1 and A2, were located between surface water sampling locations 22 and 23, nearer to 23 and upstream from the EMF facilities. Four other locations (O212DB1, O212DC1, O212DC2, and O212DC4) were located downstream of all surface water monitoring points. Specific locations were chosen in areas of quiet water, where sediments were most likely to have settled. These areas were usually near the bank or behind a barrier (e.g., a fallen tree branch, gravel bar, or island).

No sediment sample was collected from the fish hatchery because the bottom is concrete and sediment had not accumulated there.

During Phase I, elevated labels of some constituents of potential concern were observed in sediment samples in the vicinity of the IWW ditch outfall to the Portneuf River. The location of this outfall is location 17 in Figure 2.4-1. It appeared from the physical description of the sediment obtained from this location that slag from the FMC facility was present in the sample. The IWW basin and the IWW ditch that lead to the outfall were lined with slag, and slag particles scoured from the ditch may have been carried by the discharge water to the outfall. Where the discharge enters the stream, the slag could have been deposited due to the drop in velocity at the discharge point. To evaluate this possibility, additional sediment samples were collected during Phase II (July 1993) field activities in the vicinity of the outfall, and at two other locations.

2.4.2.2 Sampling and Analysis Procedures

The following section describes the documentation, sampling, and decontamination procedures followed during sediment sampling. The section also describes laboratory procedures used for chemical and radiological analyses of both surface water and sediment sampling.

Sediment Sampling Procedures

The sample locations chosen were away from strongly flowing stream areas. July/August 1992 samples were collected using a piston-type tubular sampler. Subsequent samples (November to December 1992) were collected using a piston-type or hammer-driven sampler. The samplers were driven approximately 6 inches into the river bed and withdrawn carefully so that the samples were contained in the samplers and were minimally disturbed. The samples were extruded from the tube into appropriately labeled sample jars with the aid of a stainless steel spatula.

One sample location (C3) did not contain sufficient depth of fine-grained sediments to allow sample collection with tubular (piston-type or hammer-driven) samplers. For this sample location only, a dredge bucket apparatus was used to obtain a sample with as much fine-grained sediments as possible.

Sampling Equipment Decontamination

In July and August 1992, all sampling equipment was decontaminated after use by spraying it with a solution of deionized water and phosphate-free detergent and then scrubbing with a steel or plastic brush. It was then sprayed again with deionized water and phosphate-free detergent and thoroughly rinsed with deionized water.

In December 1992, subzero weather conditions restricted the use of spray bottles. The sampling equipment was decontaminated with an identical sequence of detergent, scrubbing, detergent and rinse, but the liquids were poured rather than sprayed.

In addition, a different sediment sampler was used in December 1992, which allowed the use of a new, clean plastic sleeve to contain each sediment sample.

Chemical and Radiological Analysis of Sediment Samples

Sediment samples collected were analyzed for heavy metals, fluoride, orthophosphate, total phosphorus, PCBs, pH, total organic carbon (TOC), and radiological parameters. Table 2.4-4 lists the specific sediment analyses that were performed. Sulfate and potassium were added to the list of parameters for the July 1993 sediment samples. MSAI performed the chemical analyses, and GEL conducted the radiological analyses.

2.4.3 DRAINAGE INVESTIGATION

An investigation of drainage in the EMF study area was necessary to determine if there were opportunities for runoff to leave the EMF facility boundaries. The investigation consisted of a 2-day site and map inspection by a qualified hydrologist on December 2 and 3, 1992, research of published climatological and hydrological data, and hydrologic evaluations to analyze the quantity of storm runoff at the site.

The nature of the investigation was affected by the arid environment of the EMF study area. Because surface runoff occurs only during rainstorms or snowmelt, none was observable during the site inspection. However, drainage boundaries and flow paths were apparent from site topography.

It is clear from the regional topography that the Portneuf River would be the receiving water for any uncontrolled surface drainage from the EMF facilities. Following the site and map investigation, discussions with plant personnel, and preliminary evaluations, it appeared that no surface runoff is released from a typical rainstorm. The drainage system relies on the containment of runoff. At FMC, surface water is retained on the site in local depressions. At Simplot, runoff is collected in ponds for later use either on the site or, after treatment, as irrigation water. Further investigations focused on confirming whether the drainage system could contain runoff from storm or snowmelt events.

The *Superfund Exposure Assessment Manual* (EPA, 1988) does not include guidance on selecting a storm event for drainage system analysis. Existing data from the Pocatello Airport Weather Service Office was examined, and the largest storm event recorded in over 40 years of operation of the facilities was selected for stormwater drainage analysis.

Climatological data collected and analyzed included rainfall records of the Pocatello Airport Weather Service Office, published by the National Weather Service. Historical snow course measurements for the Wildhorse Divide SNOTEL site were obtained from the SCS office in Boise, Idaho. Data needed to compute a storm depth-duration-frequency table were obtained from the National Oceanic and Atmospheric Administration (NOAA) atlas for Idaho. Independent storm event statistics were extracted from an EPA report (EPA, 1989b).

The EMF facilities were divided into independent drainage areas for analysis. The separate drainage areas were modeled using the hydrologic model HEC-1, developed by the U.S. Army Corps of Engineers. Where applicable, storage routing through ponds was established and maximum water levels were calculated. Because runoff from the Michaud Creek and the western portion of the FMC facility collect in the same depression, both drainage areas were modeled together. The results of all calculations are presented in Section 3.2.

Surface and Subsurface Characterizations
Tables for Section 2.4

TABLE 2.4-1
SURFACE WATER AND SEDIMENT INVESTIGATION
SAMPLING SUMMARY (1992 - 1993)

Location	Sampling Date				Flow Rate Measured				Location Description
	1992		1993		07/92	10/92	02/93	04/93	
OFFSW01	28-Jul	28-Oct	4-Feb	1-May	Yes	Yes	Yes	Yes	River Mile 10
OFFSW02	28-Jul	28-Oct	5-Feb	1-May					Eastern Springs
OFFSW03	28-Jul	28-Oct	4-Feb	30-Apr	Yes	Yes	Yes	Yes	River at Siphon Road
OFFSW04	28-Jul	28-Oct	5-Feb	30-Apr					Springs at Siphon Road
OFFSW05	29-Jul	29-Oct	4-Feb	30-Apr					River at Fish Farm
OFFSW05E				30-Apr					Channel at Fish Farm - West Fork
OFFSW05F				30-Apr					Channel at Fish Farm - East Fork
OFFSW06	29-Jul	28-Oct	7-Feb	29-Apr					Pond at Fish Farm
OFFSW07	29-Jul	27-Oct	7-Feb	29-Apr					Springs at Fish Farm
OFFSW07E				29-Apr					River across from Fish Farm
OFFSW08	29-Jul	27-Oct	4-Feb	29-Apr					River at FMC Park
OFFSW09	29-Jul	28-Oct	2-Feb	29-Apr					Springs at FMC Park
OFFSW10	30-Jul	27-Oct	4-Feb	29-Apr	Yes	Yes	Yes	Yes	River at Batiste Springs discharge
OFFSW11	30-Jul	27-Oct	7-Feb	29-Apr					Batiste Springs at creamery
OFFSW12	30-Jul	27-Oct	4-Feb	29-Apr					River above STP discharge
OFFSW12E				29-Apr					River at STP discharge
OFFSW13	30-Jul	28-Oct	2-Feb	29-Apr					Springs near STP
OFFSW14	31-Jul	27-Oct	3-Feb	28-Apr					Batiste Springs
OFFSW15	31-Jul	26-Oct	2-Feb	28-Apr					Springs near Batiste Road
OFFSW16	31-Jul	26-Oct	3-Feb	28-Apr	Yes	Yes	Yes	Yes	River at Batiste Road
OFFSW17	31-Jul	26-Oct	3-Feb	28-Apr					River at FMC discharge
OFFSW18		26-Oct(a)							River at old FMC discharge
OFFSW19	1-Aug	26-Oct	6-Feb	28-Apr					River near gypsum stack
OFFSW20	1-Aug	5-Nov	6-Feb	27-Apr					River near gypsum stack
OFFSW21	1-Aug	26-Oct	6-Feb	27-Apr					River upstream of gypsum stack
OFFSW22	2-Aug	26-Oct	3-Feb	27-Apr					River Mile 15
OFFSW23	2-Aug	26-Oct	5-Feb	27-Apr					River downstream of RR sites
OFFSW24	2-Aug	26-Oct	2-Feb	27-Apr					River upstream of RR sites
OFFSW25	2-Aug	26-Oct	2-Feb	27-Apr	Yes	Yes	(b)	Yes	River upstream of Pocatello

Notes: (a) Sample not required for compliance with EMF RI/FS SAP.
(b) Measurement not possible because of river ice.

Table 2.4-2
Surface Water Field Data Summary

Phase I Sample ID	OFFSW01	OFFSW02	OFFSW03	OFFSW04	OFFSW05	OFFSW05E	OFFSW05F	OFFSW06	OFFSW07	OFFSW07E	OFFSW08	OFFSW09	OFFSW10	OFFSW11	OFFSW12	OFFSW12E	OFFSW13
Dissolved Oxygen (mg/l)																	
Jul-92	9.2	7.8	5.5	5.0	6.2	Not Sampled	Not Sampled	9.4	8.1	Not Sampled	7.4	10.6	7.6	8.8	9.2	Not Sampled	8.6
Oct-92	8.6	8.4	8.8	7.4	8.3	Not Sampled	Not Sampled	8.7	7.2	Not Sampled	7.9	9.2	7.0	13.4	8.3	Not Sampled	7.6
Feb-93	10.2	8.0	10.8	7.5	9.0	Not Sampled	Not Sampled	7.8	5.7	Not Sampled	10.0	8.3	8.8	7.1	10.4	Not Sampled	8.3
Apr-93	9.8	7.0	7.9	7.2	8.0	8.2	9.4	8.5	8.8	10.2	8.0	11.9	7.6	7.4	8.0	7.3	7.8
pH																	
Jul-92	7.31	7.63	7.32	7.51	7.75	Not Sampled	Not Sampled	7.67	7.69	Not Sampled	7.78	7.64	7.85	7.63	7.28	Not Sampled	7.35
Oct-92	7.70	7.65	7.59	7.5	7.6	Not Sampled	Not Sampled	7.67	7.57	Not Sampled	7.8	7.35	7.21	8.02	7.36	Not Sampled	7.1
Feb-93	8.11	8.41	9.93	8.13	8.11	Not Sampled	Not Sampled	7-8(b)	7-8(b)	Not Sampled	7.88	8.25	7.78	7-8(b)	7.72	Not Sampled	8.27
Apr-93	8.0	8.0	8.0	8.0	8.0	8.0	8.2	8.2	8.1	7.9	8.0	8.0	8.0	7.6	7.9	8.0	7.5
Conductivity (µmhos/cm)																	
Jul-92	584	402	644	455	433	Not Sampled	Not Sampled	449	442	Not Sampled	619	672	497	531	705	Not Sampled	705
Oct-92	738	488	761	467	645	Not Sampled	Not Sampled	519	522	Not Sampled	803	645	856	585	816	Not Sampled	777
Feb-93	1280	510	1320	720	690	Not Sampled	Not Sampled	(c)	(c)	Not Sampled	1030	1007	1120	(c)	1020	Not Sampled	1070
Apr-93	605	485	616	485	618	519	535	519	523	617	634	647	649	711	806	614	759
Temperature (deg F)																	
Jul-92	63.8	69.6	67.3	71.4	57.9	Not Sampled	Not Sampled	60.4	59.3	Not Sampled	69.8	67.7	58.2	61.1	66.3	Not Sampled	66.5
Oct-92	62.6	52.0	64.6	59.4	61.5	Not Sampled	Not Sampled	59.3	59.1	Not Sampled	59.8	59.2	60.2	58.8	56.0	Not Sampled	66.4
Feb-93	45.0	50.2	64.6	42.7	49.2	Not Sampled	Not Sampled	51.6	53.6	Not Sampled	42.5	45.5	41.1	43.0	42.3	Not Sampled	40.0
Apr-93	55.0	63.0	52.3	53.2	52.2	54.3	56.1	54.9	54.7	51.6	54.0	59.9	53.6	53.6	54.0	52.7	55.2

Table 2.4-2 (continued)
Surface Water Field Data Summary

Phase I Sample ID	OFFSW14	OFFSW15	OFFSW16	OFFSW17	OFFSW18	OFFSW19	OFFSW20	OFFSW21	OFFSW22	OFFSW23	OFFSW24	OFFSW25
Dissolved Oxygen (mg/l)												
Jul-92	7.6	3.6	8.3	7.8	Not Sampled	7.8	7.5	8.9	6.7	7.8	6.3	17.0
Oct-92	7.2	4.3	9.8	10.4	10.4	9.8	10.2	10.2	10.4	9.8	11.2	12.2
Feb-93	14.9	10.5	14.0	12.8	Not Sampled	11.8	14.1	(d)	16.4	12.8	13.5	15.2
Apr-93	4.8	6.2	10.0	9.6	Not Sampled	11.0	9.8	10.6	10.5	9.8	9.8	8.8
pH												
Jul-92	7.45	7.04	7.61	8.48	Not Sampled	8.16	8.19	8.32	8.24	8.46	8.44	8.74
Oct-92	7.51	7.38	8.68	8.68	8.64	8.74	9.7	8.7	8.65	8.47	8.42	8.46
Feb-93	7.95	7.98	8.83	8.61	Not Sampled	7-8(b)	8.72	(d)	8.68	8.64	8.03	8.24
Apr-93	6.8	7.4	8.4	8.4	Not Sampled	8.0	8.5	8.5	8.4	8.4	8.4	8.4
Conductivity (µmhos/cm)												
Jul-92	484	773	601	708	Not Sampled	542	512	522	616	662	683	734
Oct-92	642	1090	863	880	875	768	863	847	850	873	873	879
Feb-93	1230	1245	2140	1350	Not Sampled	(c)	1190	(d)	1160	1290	1082	943
Apr-93	1192	860	572	626	Not Sampled	583	567	574	566	573	566	578
Temperature (deg F)												
Jul-92	56.5	59.9	64.7	78.5	Not Sampled	68.6	71.9	75.9	70.5	73.1	71.6	80.8
Oct-92	58.4	55.0	54.6	53.5	54.3	69.0	54.8	60.0	58.6	56.3	57.6	57.2
Feb-93	44.1	44.5	46.0	41.8	Not Sampled	32.0	32.5	(d)	42.0	36.6	39.1	35.0
Apr-93	56.1	54.7	51.1	59.0	Not Sampled	51.8	53.2	53.2	52.5	51.1	50.9	50.0

Surface Water Field Data Summary from Cross-Sectional Survey @ SW17

Phase II Sample ID	O307W17A	O307W17B(a)	O307W17C(a)	O307W17D	O307W17E(a)	O307W17F	O307W17G	O307W17H	O307W17I	O307W17J
Dissolved Oxygen (mg/l)										
27-Jul-93	8.2	8.2	8.2	7.4	7.4	8.6	8.0	7.6	8.4	8.2
pH										
27-Jul-93	8.6	8.6	8.6	8.7	8.7	8.6	8.6	8.5	8.4	8.8
Conductivity (µmhos/cm)										
27-Jul-93	954	954	954	964	964	904	892	894	896	864
Temperature (deg F)										
27-Jul-93	64.8	64.8	64.8	64.0	64.0	62.1	61.2	61.0	61.2	62.2

Notes:
(a) Quality control sample. (b) Measured with pH paper.
(c) Not measured. (d) Inaccessible due to river ice.

TABLE 2.4-3
ANALYTICAL PARAMETERS FOR SURFACE WATER SAMPLES

I. Heavy Metals[a]	II. Water Quality Parameters
Aluminum	Alkalinity (bicarbonate)
Antimony	Alkalinity (carbonate)
Arsenic	Ammonia
Barium	Calcium
Beryllium	Chloride
Boron	Conductivity
Cadmium	Dissolved oxygen
Chromium	Fluoride
Cobalt	Hardness[b]
Copper	Magnesium
Iron	Nitrate
Lead	pH
Lithium	Phosphorus (total)
Manganese	Phosphorus (orthophosphate)
Mercury	Potassium
Molybdenum	Sodium
Nickel	Sulfate
Selenium	Temperature
Silver	Total dissolved solids
Thallium	Total suspended solids
Vanadium	**III. Radioactivity**
Zinc	Radium 226/228
	Gross alpha and beta
	Uranium-234/238[c]

Notes: (a) Both unfiltered and filtered surface water samples submitted for metals analysis.
(b) Third and fourth quarters only.
(c) Third quarter only.

TABLE 2.4-4
ANALYTICAL PARAMETERS FOR SEDIMENT SAMPLES

I. Heavy Metals	**II. General Minerals**
Aluminum	Fluoride
Antimony	Phosphorus (total)
Arsenic	Phosphorus (orthophosphate)
Barium	Sulfate[(a)]
Beryllium	Potassium[(a)]
Boron	**III. Radioactivity**
Cadmium	Gamma spectrometry
Chromium	Gross alpha and beta
Cobalt	**IV. Other**
Copper	pH
Iron	Total organic carbon (TOC)
Lead	Polychlorinated biphenyls (PCBs)
Lithium	
Manganese	
Mercury	
Molybdenum	
Nickel	
Selenium	
Silver	
Thallium	
Vanadium	
Zinc	

Notes: (a) July 1993 sediment samples only.

Surface and Subsurface Characterizations
Figures for Section 2.4

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Figure 2.4-1

2.5 LAND USE AND DEMOGRAPHY SURVEY

Investigations were conducted to characterize demographics and land use in the EMF study area. Information regarding potential receptors of EMF-related constituents and groundwater usage in the study area was also collected.

Demographic data describing the populations living in the study area were collected from Bannock and Power counties' planning agencies and the cities of Pocatello and Chubbuck. This information is presented in Section 3.6.

Current land uses were determined based on zoning maps of the cities of Pocatello and Chubbuck, and Bannock County; 1992 aerial photographs; and a windshield reconnaissance in October 1992. The aerial photographs and windshield survey verified current land uses outlined on zoning maps. Land use in Power County was based on windshield reconnaissance and 1992 aerial photographs.

Future land uses were based on comprehensive plans of the cities of Pocatello and Chubbuck, and Bannock County. Power County does not have a comprehensive plan, but is in the process of developing one.

Locations of groundwater wells in the study area were obtained from the Idaho Department of Water Resources data files. Wells in these data files were not recorded to distinguish between potable, irrigation, or livestock uses. Locations were mapped and are presented in Section 3.6.

Locations of potential receptors as defined in the RI/FS Work Plan (Bechtel, 1992b), were determined through agency contacts, and are discussed in Section 3.6.

A well canvas was not conducted during the investigation. However, state records were searched and any private wells registered in the EMF study area were noted. The results of this search are presented in Section 3.6.

2.6 ECOLOGICAL SURVEY

An ecological survey was designed to collect data on the terrestrial and aquatic biological resources on and in the vicinity of the EMF facilities. A phased approach was used for the RI. The survey included a literature review and site reconnaissance to identify special status species and habitats in the area as well as areas of biological importance (Bechtel, 1992b).

The survey covered an area within a 3-mile (4.8-km) radius of the EMF facilities. Field reconnaissance was conducted in September 1992, February 1993, and June 1993. During the September 1992 reconnaissance, local experts and government agencies were contacted regarding biological resources in the EMF study area, which include special status species as well as habitats and species targeted for human consumption. Special status species include those that are listed as threatened or endangered by the state or federal government and those that are candidates for listing. Sensitive habitats include wetlands, streams and riparian zones, critical habitats designated for threatened or endangered species, and habitats designated by state and federal agencies as special.

The field reconnaissance in September 1992 involved a 4-day ground survey of the area. Representatives of the EPA and U.S. Fish and Wildlife Service (U.S. FWS) participated in the reconnaissance survey of the surrounding areas. All major habitat types were examined, including wetlands delineated by the U.S. FWS within the area (U.S. FWS, 1980). Prevalent plant and animal species were noted, as were signs of any observed stress.

Because of the time of year, prevalent plant species were identified only on the basis of vegetative characteristics. Further investigation in May 1993 provided additional information on plant species composition, characteristics of plant communities, and existing stresses in the area. Agricultural areas were surveyed, and fallow land, crop land, and wooded areas were noted.

In September 1992, the Portneuf River was examined at street and highway bridges in Pocatello (near river mile 17 and downstream). The river was also examined by boat between the bridge at

I-86 (river mile 13.4) and Siphon Road (river mile 11), and from I-86 to Reservation Road (near river mile 8.2). The river near the FMC and Simplot facilities (river mile 13.5) was examined on foot. Bottom substrate, macroinvertebrates, fish, general water quality, macrophytes, and adjacent riparian wetland vegetation composition were noted qualitatively. In October 1992, habitats adjacent to sediment and water quality sampling locations were characterized during water quality sampling. In addition to the parameters noted during the September trip, water depth and flow, and bank height were determined, as were the general community structures and species composition of the adjacent riparian and wetland habitats.

During the reconnaissance, a vegetation cover and habitat map were prepared based on aerial photographs and field verification. Wetlands identified by the U.S. FWS wetland inventory maps (1980) were also visually checked for presence, condition, and species composition.

In February 1993, the Portneuf River was surveyed by boat on three successive days from approximately 8:30 a.m. to 12:00 p.m. to characterize use by waterfowl and raptors along the river. The survey began in Pocatello at about river mile 16.5 and extended downstream to about river mile 9.5, which is about 2.5 miles above the high water level of the American Falls Reservoir.

The May 1993 field reconnaissance included a 4-day ground survey that examined sensitive habitats that may have been affected by constituents originating from the EMF facilities. The purpose of the survey was to look for evidence of existing stresses and to further identify the occurrence and use of habitats by sensitive species in the area. Areas for reconnaissance were selected on the basis of the analysis of water quality, sediments, and soils. Particular emphasis was placed on areas in which the concentrations of constituents were found to be higher than background. Habitats were examined for general conditions of vegetation, including species composition. These conditions were evaluated by surveying the river from Batiste Springs to approximately river mile No. 10 of the Portneuf River and field reconnaissance of Michaud

Creek. The habitats of nesting raptors, nesting colonial waterbirds, and waterfowl along the Portneuf River, Michaud Creek, and the cliff habitat south of the EMF facilities were examined.

The potential habitat for Townsend's big-eared bat in the bluffs south of the EMF facilities was searched for evidence of the species. The bat is being proposed for listing as a threatened or endangered species. Cliff areas above the Simplot gypsum stack on the southern portion of the Simplot property were examined in particular. Two personnel were positioned to observe any flying bats from sundown to one hour after sundown. In addition, reported nesting locations of golden eagles and prairie falcons in this area were examined for evidence of active raptor nests.

2.7 ECOLOGICAL INVESTIGATIONS

At the request of EPA, additional field studies were undertaken for the purpose of evaluating potential risks to ecological receptors. Consequently, the ecological field investigation described in this section is not contained in the original RI/FS Workplan (Bechtel, 1992b), which was the basis for the investigations described in the previous sections. The ecological field investigations were developed as a separate entity from the RI/FS Workplan and are described in detail in the Ecological Field Sampling Plan (EFSP) (Bechtel, 1994m) (Appendix R). This section summarizes both the terrestrial and aquatic field sampling efforts and includes additional information concerning deviations from the EFSP.

EPA proposed the ecological field investigations to obtain site-specific data regarding potential risks to EMF-related ecosystems. The terrestrial ecosystems of concern were the upland sagebrush steppe habitats of the Michaud Flats and Bannock Hills, and the riparian habitats of the Portneuf River. The aquatic ecosystems of concern were the Portneuf River in the vicinity of the IWW Ditch Outfall, and the Portneuf River Delta near the confluence of the Portneuf River and the American Falls Reservoir (AFR). Specific discussion of habitat type and the organisms (receptors) in the vicinity of the EMF facilities is provided in Section 3.7. A summary of the findings of the ecological field investigations and their significance is provided in Section 4.6.

2.7.1 AQUATIC INVESTIGATIONS

As part of the ecological study, EPA requested an aquatic investigation consisting of two components: 1) the IWW Ditch Outfall investigation in the Portneuf River, and 2) the Portneuf River Delta studies of the delta prior to its discharge into the AFR located approximately 5 miles downstream of the IWW Ditch Outfall. These studies supplement the studies of the Portneuf River surface water and sediment analyses described in (Section 2.4). Whereas those Portneuf River studies refer to Phases I, II, and III, the terminology for the ecological aquatic investigation is Delta Phases I and II.

Although the objective of both the terrestrial and aquatic investigations was to determine potential EMF-related risks associated with the aquatic ecosystems, the specific objectives, and consequently methodological approaches, differed between the two ecological investigations. The contaminants of potential concern (COPCs) identified in the terrestrial investigations were cadmium, fluoride, and zinc. In addition to these three inorganics, the aquatic investigation also included arsenic, mercury, and selenium. Arsenic, cadmium, fluoride, and zinc were chosen by EPA as COPCs in the aquatic investigation because elevated concentrations were intermittently detected either at the IWW Ditch, the IWW Ditch Outfall, or at Batiste or Swanson Road Springs. EPA requested the inclusion of mercury and selenium because of their bioaccumulation potential.

In the following discussion, the objectives and methodologies employed in the aquatic field investigations are summarized. A detailed description of the studies is contained in the EFSP (Appendix R).

2.7.1.1 IWW Ditch Outfall Investigation

The purpose of the IWW Ditch Outfall investigation was to evaluate the potential benthic community impact of FMC's permitted NPDES discharge from the IWW Ditch Outfall. The IWW Ditch Outfall investigation required sediment sampling for both chemical analysis and toxicity testing; the extent of sampling was confined to sediments near the outfall.

IWW Ditch Outfall Sampling Procedures

As noted in Table 2.7-1, one composited sediment sample was collected along a river transect from each of three Portneuf River locations in the vicinity of the IWW Ditch Outfall. No samples were taken from the IWW Ditch. Sample locations, depicted in Figure 2.7-1, were:

- upstream of the IWW Ditch Outfall (identified as sampling station #21), indicating non-EMF related activities;

- at the IWW Ditch Outfall (identified as sampling station #17), indicating discharges from FMC activities;
- downstream of the IWW Ditch Outfall (identified as sampling station #16), indicating the extent, if any, of COPC migration from the outfall.

At each of the sampling stations, five to seven samples were collected on a transect across the river and homogenized in a stainless steel bowl as described in the EFSP. Each composite sediment sample collected was shipped to the laboratory for chemical and bioassay tests. The bioassay samples were transported and stored in the dark at a temperature of 4°C until analysis.

In addition, quality control samples for matrix spiking and field duplicate samples were collected. One rinsate blank per day was collected for sediment sampling equipment, such as the Ekman dredge and stainless steel spoons after decontamination. All equipment was rinsed into a common pool of water for subsequent analysis.

IWW Ditch Outfall Analytical Procedures

Each of the three composite sediment samples was analyzed for fluoride, ammonia, target analyte list (TAL) metals, total organic carbon (TOC), Acid-Volatile Sulfide (AVS)/Simultaneously Extracted Metals (SEM), and particle-size distribution. The methodologies used for the analyses, which, with several exceptions, were provided in the EFSP, are provided in Table 2.7-2. The three exceptions to the EFSP were:

For ammonia analysis, EPA method 350.1, rather than method 350.2, was used. Laboratory analyses indicated that the data quality and suitability were not decreased by the difference in analytical methods.

The quantitation limit for silver was 0.7 µg/g, rather than the requested 0.5 µg/g. Because silver was detected in all three sediment samples, this difference is not considered important.

The toxicity tests were conducted based on ASTM E 1383-90, rather than ASTM E 1383-93, as specified in the EFSP. As discussed with and approved by EPA, tests on both midges and amphipods were conducted for 10 days, rather than the specified 28 days.

AVS is the cold (1N HCl) acid-extractable fraction of solid-phase iron monosulfide, which preferentially binds (chemically combines with) certain metal cations in sediment (Ankley *et al.*, 1991). During the extraction process, individual metals are also simultaneously extracted. SEM/AVS ratios greater than 1 indicate increased probability that metals are bioavailable to exposed aquatic biota. TOC is used to characterize organic matter content in sediment because concentrations of certain trace metals, such as mercury, are positively correlated with the organic matter content of sediment. Particle-size distribution, which characterizes the relative fractions of clay, silt, and sand, is important because finer grained sediments often have greater trace metals concentrations. Ammonia was analyzed because toxic levels could result from high pH and/or reducing conditions at the site. Rinsate samples were analyzed for TAL metals, molybdenum, boron, ammonia, TOC, and fluoride.

Bioassay studies testing the toxicity of sediment samples to *Hyalella azteca* and *Chironomus tentans* were conducted over a ten day period. The growth and survival of test species were compared for field sediment samples and laboratory formulated reference sediments. The tests were initiated 24 hours after the introduction of the homogenized sediment and water to the test chamber with the addition of six *C. tentans* or ten *H. azteca*. Each test chamber contained 40 ml of sediments and 160 ml of overlying water (dechlorinated tap water) maintained near a target temperature of 20 ± 1^0 C. Four replicates of each sample and four control replicates were performed. Aliquots of each sediment sample were removed and analyzed for percent moisture and grain size.

2.7.1.2 Portneuf River Delta Investigation

The specific objectives of the Portneuf River Delta investigation were two-fold: 1) to determine whether Portneuf River Delta sediment COPC concentrations were significantly elevated above reference (background) levels and levels of ecological concern, and 2) to ascertain whether these concentrations, if elevated, represented a risk to receptors in the aquatic food chain. To accomplish the specific objectives, the Portneuf River Delta Studies were developed to proceed in two phases.

In the Phase I Delta Study, sediments were collected for chemical analysis. Only if the Portneuf Delta sediments indicated an EMF related cause for concern when compared to sediment levels from both background and reference site locations as well as Levels of Ecological Concern (LECs) was Phase II to proceed. The Phase II Delta Study was to include collection of sediments for bioassays and analysis of macroinvertebrates and fish for determination of bioaccumulation of COPCs in biota. To facilitate the studies, macroinvertebrates and fish were sampled during the Phase I Delta Study but were not to be analyzed unless Phase II was triggered.

The implementation of the Phase II Delta Study depended on the triggering of all of the three criteria listed below:

(1) Portneuf River Delta COPC concentrations must be significantly higher than Snake delta concentrations;

(2) Portneuf River Delta COPC concentrations must be significantly higher than upstream Portneuf concentrations;

(3) Portneuf River Delta COPC concentrations must exceed a Level of Ecological Concern (LEC).

Only those COPCs which failed all of the criteria were to proceed into Phase II. A decision analysis for the evaluation of the above criteria was provided to EPA in the November, 1994 report, "Determination of the Need to Proceed with Phase II of the EMF River Delta Study." The sample results and the statistical analysis are provided in Section 4.6 and Appendix S. The analysis demonstrated that the Phase II Delta Study was unnecessary for any of the COPCs. Consequently, only the Phase I Delta Study sampling and analysis procedures are discussed below.

Delta Sampling Procedures

Phase I of the Delta Study specified ten sediment sampling stations in the Portneuf River (Figure 2.7-2) and ten in the Snake River (Figure 2.7-3) to assess concentrations of the six inorganic COPCs and parameters which effect their bioavailability, e.g., TOC and aluminum, in the delta sediments of the AFR. At each of the 10 sampling stations, sediment samples were collected from the river channel and from adjacent mudflats. Sediment samples were collected using an Ekman dredge or directly using the collection jars or spoons. Although the EFSP had specified an equal distribution of sample locations above and below the high water line of the AFR, field conditions did not allow for an exact division. As a result, for each river channel, six of the sampling stations were located below the high water line of the AFR and four stations were located above this line. For both the Portneuf and Snake River channels, the high water line was defined by the appearance of vegetation that is seasonally submerged in the AFR. In October, during the sampling period, the AFR waters recede and both the river channels and their high water lines are clearly visible. The more elevated mudflat samples above the high water line are more properly described as floodplain soils, whereas the lower mudflats may be considered sediments. Samples were collected from near-shore depositional areas in each channel. The exact location of each sampling station was established using a portable GPS unit and is provided in Table 2.7-3.

Delta Analytical Procedures

Each of the composited sediment samples collected at each sampling station was analyzed for fluoride, ammonia, 7 TAL metals (aluminum, arsenic, cadmium, iron, mercury, selenium, and zinc), TOC, AVS/SEM, and particle-size distribution. These parameters form a subset of the variables that were studied for the IWW Ditch Outfall (Section 2.7.1.1). Rinsate samples were analyzed for TAL metals, TOC, and fluoride. The Quality Assurance Objectives for the measured parameters are described in Table 2.7-4.

2.7.2 TERRESTRIAL INVESTIGATION

The central objective of the terrestrial studies was to obtain site-specific data for EPA to develop a terrestrial food web analysis for terrestrial COPCs. The COPCs identified by EPA were cadmium, fluoride and zinc, because these inorganics are associated with facility activities and are known to adversely impact ecological receptors if present in sufficient concentrations.

Investigations were performed on the two predominant ecosystems in the EMF study area: 1) the sagebrush steppe, the dominant native upland terrestrial ecosystem, and 2) the riparian habitat bordering the Portneuf River. In the sagebrush steppe habitat, soils, vegetation, and small mammals were collected and analyzed for the three COPCs. Vegetation and soils (but not small mammals) were collected from the riparian zone bordering the Portneuf River for analysis. The field study began on September 16 and ended on September 23, 1994. Tables 2.7-5 and 2.7-6 provide an overview of the habitat, sample matrices and COPCs for the terrestrial investigation. In the following subsections, an overview of the sample locations and methodologies for sample collection and analysis are provided.

2.7.2.1 Sample Locations and Descriptions

Two potentially impacted locations representing likely exposed areas (Figure 2.7-4), and one reference location, presumed to be unaffected by EMF activities (Figure 2.7-5), were selected for sampling of the sagebrush steppe habitat. The reference location was included to allow a comparison of results between an area which may have been impacted by EMF activities to an area which was not influenced by EMF activities. In addition to Figures 2.7-4 and 2.7-5, Table 2.7-7 includes a description of each of the sample locations.

Two riparian habitat locations, one potentially impacted on the Portneuf River (Figure 2.7-4) and one reference location on the Snake River (Figure 2.7-5), were also sampled for soil and vegetation; sample locations are also described in Table 2.7-7.

Potentially impacted locations were within three miles of the EMF facilities, and were chosen based on COPC air dispersion patterns (Bechtel, 1994k; E&E, 1993). Actual sample locations were identified during field reconnaissance surveys (July and August, 1994) and observations made during the field sampling effort, with the agreement of oversight personnel representing the regulatory agencies. Reference sites with equivalent habitats were located approximately fifteen miles from the EMF facilities and were chosen in a similar manner to the potentially impacted locations. Sample locations were approximately one hectare (ha) in size. All sampling locations were beyond EMF facility boundaries.

During the field reconnaissance surveys, the investigators noted the locations of the terrestrial sampling sites on topographic maps, photographed locations to record distinguishing geographic features, and verified sample locations with a GPS. The GPS used a single benchmark near the county fairgrounds; the second originally proposed benchmark, near the intersection of Pocatello Creek and Parks Road, could not be located because of recent excavation in the area. In verifying sample locations, multiple GPS readings were obtained from at least two positions on opposite sides of each sample plot. Field personnel found that the GPS data were highly reproducible, with readings generally within 3 seconds (approximately 100 meters) latitude and longitude, and within 50 feet of elevation and the GPS data for the sites are presented in Table 2.7-8. The site locations are shown in Figures 2.7-4 and 2-7-5.

Bannock Hills (U01)

The first potentially impacted sagebrush steppe site, designated U01, was located just south of the FMC slag pile and at the base of the Bannock Hills. The 1 ha plot was subdivided into fifty 20 by 10 meter (m) subplots to facilitate vegetation and soil collection. This alternate location was chosen over sites nearer the electrical distribution substation, as originally identified in the

EFSP, because grazing had severely damaged vegetation at the latter sites. In addition, the originally designated site also had few target vegetative species (big sagebrush and thickspike wheatgrasses), and minimal evidence of deer mouse activity (the designated small mammal to be sampled). Active burrows and rodent runways indicated that mice were using the chosen Bannock Hills sample location.

Michaud Flats (U02)

The Michaud Flats site, the second potentially impacted sagebrush steppe site, was located on a knoll between the Portneuf River and FMC Park, as specified in the EFSP. Because of the distribution of vegetation, investigators laid out the sampling plot as two adjacent rectangles encompassing a total of 0.75 ha. One rectangle measured 60 by 25 m, and the second measured 150 by 40 m. Due to the abundance and spatial distribution of the vegetation, the sizes of the subplots at this site were 10 by 25 m and 20 by 20 m. The surrounding Uplands were severely disturbed by activities associated with the park, adjacent sand excavation, and a recent fire. However, the sampling site showed extensive deer mouse activity, as evidenced by runways, freshly dug burrows, and droppings. In addition to target vegetation, vegetation types included greasewood, Russian Olive, cottonwood, and prickly pear cactus.

Ferry Butte (U03)

The Ferry Butte sagebrush steppe reference location was near the Snake River, approximately two kilometers east of the Tilden Bridge, on a north-facing slope of approximately 20 percent. The sample area was a square 1 ha plot divided into 25 subplots for ease of sampling soils and vegetation.

Portneuf River

The Portneuf River site, approximately 1 mile north-northeast of the EMF facilities, represents the potentially impacted riparian habitat. An approximately 500 m long transect was located on each bank of the river, near Batiste Spring. A series of 50 m transects were designated and flagged for potential sampling of vegetation and soils. Selected transects contained at least two fruit-bearing Russian Olive trees, the target species.

Snake River

The Snake River site was chosen as the riparian reference site and was located along the Snake River just below the mouth of the Blackfoot River, approximately 15 miles north-northeast of the EMF facilities. Because there were no Russian Olive trees along the north bank, a transect was established only along the south bank. The area was heavily grazed, minimizing the undergrowth cover. However, numerous Russian Olive trees, with sufficient fruit for sampling, were present.

2.7.2.2 Soil Samples

Soil Sampling Procedures

Soil samples were obtained at the same time as vegetation samples and were intended to determine the relationship between vegetation and soil COPC concentrations. Consequently, soil samples were obtained in the immediate vicinity of the sampled sagebrush, grasses, and Russian Olive trees. Ten soil samples were collected from within one meter of the canopy of sagebrush plants collected for vegetation analysis. Similarly, soil was collected at the base of Russian Olive trees where fruit was collected in each of 10 randomly selected subplots in each of the riparian habitats: The soil was collected from a depth of zero to 2 inches from at least two locations within each randomly selected subplot and composited to form a single sample for each subplot. All samples from a subplot were then composited. Soil samples were collected using either a stainless steel trowel or a laboratory-cleaned glass sample jar. All samples from a subplot were composited in a clean polyethylene bag, mixed, and transferred into a glass sample jar. Samples were stored in a cooler at 4°C for transport to the analytical lab.

Soil Analytical Procedures

Data Quality Objectives are provided in Table 2.7-9. Composited surface soil samples were analyzed for cadmium and zinc using EPA SW846 method 6010A. Fluoride was digested using method ASA 26.4.3.4 and analyzed using EPA SW846 method 6010A. Additional soil parameters included pH, cation exchange capacity (CEC), soluble cation concentrations, and TOC. The two exceptions to the methodologies described in the EFSP were:

- For pH analysis, EPA method SW 846-9045, rather than method ASA method 12-2.6, was used. Laboratory analyses indicated that the data quality and suitability for the risk assessment were not diminished by the difference in analytical methods.
- For cadmium and zinc analyses, digestion was performed by EPA method SW 846-3050A as specified in the EFSP. The analyses were performed by Inductively Coupled Plasma (ICP) (EPA method SW846-6010A) rather than EPA methods SW846-7131 and SW846-7951 as indicated in the EFSP. All the analyses for zinc had detectable levels of zinc for the method used (ICP), indicating that a lower detection limit was not needed for this constituent. Of the 40 samples analyzed for cadmium, 23 had detectable levels a safe margin above the instrument detection limit (IDL) (at least 5x the IDL) for the method used. The samples and the rinsates for which no detectable levels were reported (U qualified) were re-analyzed by graphite furnace atomic absorption (GFAA) (EPA method SW846-7131) to reach the lower quantitation limits requested in the EFSP. Analyses of the methods used and those specified in the EFSP indicates the data quality is not diminished by the difference in analytical methods.

In addition, mineralogical analyses were performed on soil samples to evaluate COPC bioavailability. Specifically, the purpose of the mineralogical analyses was to determine the feasibility of assessing COPC chemical form and associated mineral assemblage as a measure of bioavailability. The cadmium, fluoride, and zinc-bearing minerals in soils were evaluated using a JEOL 8600 Electron Microprobe Microscopy at the University of Colorado. Arsenic analyses were also included because of its potential concern for human health. To test the feasibility of this study, the mineralogical analyses were to be conducted in two phases. In Phase I, only the soil sample with the highest COPC concentrations (Bannock Hills) and a single on-site source material (slag) were analyzed to determine whether the concentrations would be high enough to perform ionic speciation for each COPC. Because the concentrations were not sufficient for mineralogical analyses, Phase II, which would have included the actual assessment of the extent of bioavailability, was not initiated. The results are discussed in Section 4.6.

In addition, quality control samples for matrix spikes and field duplicate samples were collected. One rinsate blank per day was collected for soil sampling equipment. All equipment was rinsed into a common pool of water for subsequent analysis.

2.7.2.3 Vegetation Samples

COPC vegetation analyses were performed to provide a measure of concentration in the food of herbivores and an estimate of the relationship between vegetation and soil concentrations. The latter parameter is referred to as the uptake factor between vegetation and soil, which may be relevant to both ecological and human exposure receptors. The type of vegetation sampled was chosen on the basis of abundance in the target habitats and their relevance to ecological receptors.

The dominant vegetation in the sagebrush steppe habitat consisted of sagebrush and thickspike wheatgrass. The sagebrush target species was present as two subspecies. One subspecies has slightly larger leaves, prefers deep, well-drained soils, and is frequently associated with deer mouse habitats. The second subspecies has smaller leaves with more prominent lobes, and is a preferred food for antelope and, potentially, mule deer. Both subspecies were collected indiscriminately for COPC analysis, depending on availability in each sample plot. Grasses were collected as described below. The only vegetation collected in the riparian habitat was Russian Olive fruits, which are a food source for birds.

Vegetation Sampling Procedures

Details of vegetation sampling techniques, including clipping, bagging, weighing, storage, shipment, and chain-of-custody, are provided in the EFSP (Appendix R) and the Ecological

Quality Assurance Project Plan (EQAPjP), (Bechtel, 1994l). The plots/transects were divided into subplots that were randomly chosen for sample collection. In the sagebrush habitat, plots up to 1 ha in size were subdivided into subplots to facilitate vegetation and soil collection. The square plots were 1 ha at Bannock Hills and Ferry Butte. Because of the small area associated with suitable vegetation, the Michaud Flats plot consisted of two adjacent rectangles covering a total of 0.75 ha. At each of the three sagebrush steppe sampling locations, 20 subplots were sampled for sagebrush. In each riparian habitat, transects totaling 1,000 m in length were established along the river bank, and 50 m subplots were established for sampling. Investigators collected 10 Russian Olive samples and 10 soil samples from randomly selected subplots at each riparian location. A drawing of a random selection of subplots/transects developed prior to the field investigation and included in the EFSP was used to determine which subplots/transects would be sampled for vegetation and soils.

Field personnel collected a composited vegetative sample of 100 grams from thickspike wheatgrass in each subplot. Typically, 10 subplots were sampled for wheatgrass. Wheatgrass samples consisted of stems and leaves clipped at least 2 centimeters (cm) above ground level. Numerous wheatgrass plants from each subplot were sampled and composited for the necessary sample weight. Because samples were collected at the end of the growing season, grasses were dormant and dehydrated such that the dehydrated above-ground biomass tends to contain the highest concentrations of any season.

Composited sagebrush samples were obtained from 20 selected subplots. Ten samples were analyzed for cadmium and zinc, and twenty were analyzed for fluoride. A larger number of samples was needed for fluoride because fluoride concentrations between samples is typically highly variable. Field personnel sampled between two and five individual sagebrush plants to obtain at least 200 grams of vegetation at each subplot. Only the current year's sagebrush growth of vegetative shoots and leaves which are the prevalent food source were obtained from each subplot. Flowers and flower stalks (that is, reproductive components of the plants) were not included in the samples.

In the riparian habitats, at least 50 Russian Olive fruits, a food source of birds, were collected from 2 trees in each transect for COPC analysis. Additional discussion of the sampling activities at each sample location is provided below.

Bannock Hills

Subplots were restricted to 10 m by 20 m areas. Vegetation was collected in two additional subplots, located adjacent to the main plot, to attain the goal of 20 sagebrush samples. Ten subplots were sampled for grass and twenty subplots for sagebrush. All grass and soil samples were collected from subplots within the main plot. The plot contained an irregular distribution of two species of sagebrush (including the target species), mixed with various grasses and a variety of broadleaved plants.

Michaud Flats

Six north end subplots were limited to 10 m by 25 m areas, while the remaining subplots were 20 m by 20 m. Investigators sampled 20 subplots for sagebrush; the sagebrush target species was the predominant vegetation type. A total of 10 subplots were sampled for grass. The target species, thickspike wheatgrass, was a dominant grass type.

Ferry Butte

All subplots, 20 m by 20 m in area, had an adequate amount of sagebrush vegetation for sampling in this reference area. Grasses were sparser here than in the potentially impacted areas, but did include thickspike wheatgrass. A total of 10 subplots were sampled for grass and 20 subplots for sagebrush.

Riparian

Investigators selected subplots with at least two fruit-bearing Russian Olive trees. At the Portneuf River, two Russian Olive trees within 10 m of the river bank were randomly selected within each of the transect's subplots. At the Snake River, the two Olive trees closest to the river bank were selected. Because the Snake River bank was not well delineated, the exact distance from the edge of the bank could not be determined with certainty. A total of 25 mature fruits were collected from each tree.

Vegetation Analytical Procedures

Vegetation was analyzed for cadmium, fluoride and zinc. Analytical methods for cadmium and zinc in vegetation could not be performed by the laboratory as initially specified in the EFSP (Appendix R). Therefore, a letter was sent to EPA on November 23, 1994, requesting the analytical methods for cadmium and zinc conform to standard EPA methods. The request was approved by EPA. The following provides a description of the analytical procedures for cadmium, fluoride and zinc, which is summarized in Table 2.7-9.

Field vegetation and fruit samples were digested for cadmium and zinc analyses using EPA's SW846 method 3050. Cadmium and zinc concentrations were analyzed by EPA method 6010A. Cadmium samples were analyzed using TRACE ICP (Inductively Coupled Plasma), which is capable of achieving comparable detection limits as GFAA analysis. In practice, the cadmium detection limit obtained by TRACE ICP analysis was slightly above the requested quantitation limit (EPA, 1994b) of 0.005 mg/kg.

Fluoride samples were digested using AOAC method 3.086. However, prior to sample digestion, half of the sagebrush vegetation samples obtained from each subplot were washed according to AOAC 3.085. The washing was performed to provide a comparison between washed and unwashed vegetation, primarily for the purpose of ascertaining the fluoride fraction incorporated through airborne deposition. Fluoride analyses were performed according to AOAC method 3.087 as specified in the EQAPjP. Determination of the relative amount of cadmium and zinc airborne deposition were secondary issues. The single exception to the methodologies described in the EFSP was:

For cadmium and zinc analyses, sample detection was conducted using ICP (EPA method SW846-6010A), rather than the AOAC methods specified in the EFSP. All of the analyses (except for rinsates) had detectable levels of zinc for the method used (ICP), indicating that a lower detection limit was not needed for this constituent. Of the 87 samples analyzed for cadmium, 53 had detectable levels a safe margin above the IDL (at least 5x the IDL) for the method used; however, 8 were at or very near the detection limit. The samples for which no detectable levels were reported (U qualified), and those samples at or very near the detection limit, were redigested using EPA promulgated method 200.3, and reanalyzed by GFAA using EPA promulgated method 213.2 to reach the lower quantitation limits. The EFSP specified quantitation limit of 0.005 mg/kg for cadmium could not be reached by these methods and was raised to 0.01 mg/kg.

2.7.2.4 Small Mammal Samples

The purpose of small mammal collection was to determine site-specific COPC concentrations in prey of the sagebrush steppe habitat; deer mice were chosen as the representative prey species. Small mammals were trapped only in the sagebrush steppe habitat.

Whole mouse body concentrations were analyzed for the COPCs cadmium, zinc, and fluoride. However, because fluoride is preferentially deposited in skeletal tissue, most of the skeletal concentration may not be bioavailable to top predators. Predators preferentially ingest soft tissue or, if the whole body is ingested, the skeleton may not be digested. Therefore, a separate analysis for fluoride concentrations in mouse femur (thigh bone) was conducted. For the purposes of this analysis, the femur fluoride concentrations was considered to be representative of total skeletal concentrations. By subtracting the skeletal concentration from the whole body burden, an estimate of the bioavailable fluoride fraction was obtained.

An overview of the sampling procedures and analytical methods are discussed below, and are summarized in Table 2.7-9.

Small Mammal Sampling Procedures

Ten mice were collected for analysis of COPCs from each of the two potentially impacted sagebrush habitat locations (Bannock Hills and Michaud Flats) and the reference sagebrush habitat location (Ferry Butte). No trapping of small mammals was conducted in the riparian habitats.

Details of mouse collection techniques are provided in the EFSP and are summarized here. For two days prior to collection, baited snap-traps were placed in the field but were not set. Traps were placed in runways, near active burrow holes, or in other suitable mouse habitat throughout the subplot. Traps were baited with approximately 1 to 2 grams of a 1:1 mixture of peanut butter and oat kernels, consisting of 6 to 12 kernels per trap. After two days, traps were pre-baited and set at dusk. Specimens were collected the morning after trapping with precautions taken to avoid exposure to hantavirus. Trapped mice were placed in polyethylene bags, labeled, and stored in a portable freezer until shipment. Sampling of vegetation and soils were not performed until sufficient numbers of mice were obtained for analysis. The following provides a summary of small mammal collection activities at each sampling location.

Bannock Hills

Five adult males, one juvenile male, and three adult female deer mice were collected on the first day. The next day, investigators collected one adult male, one adult female, and one juvenile male. These mice were primarily "young of the year". None of the females appeared to be pregnant. All ten adult deer mice were shipped for COPC analysis.

Michaud Flats

All collections took place on September 19, 1994. A total of 19 adult males, 20 adult females, one juvenile female, and two partially damaged specimens, were collected. Most of the adults were of breeding age, and several pregnant females were collected. Five males and five females were randomly selected for analysis. Pregnant females and juveniles were excluded from analysis.

Ferry Butte

At this location, 18 adult males, 23 adult females, five juvenile males, and five juvenile females were collected on a single day. Several of the female mice appeared pregnant. Five males and five females were randomly selected for analysis. Pregnant females and juveniles were excluded from analysis.

Small Mammal Analytical Procedures

Mice were split along the midline (the length of the backbone) for analysis of whole body concentrations of zinc, cadmium and fluoride. Laboratory investigators analyzed for whole body concentrations of cadmium and zinc in one half, and for fluoride (whole body) in the other half. Both femurs from each mouse were analyzed together for the purposes of determining the amount of fluoride skeletal deposition.

Analytical methodologies specified in the EFSP and the EQAPjP were altered during small mammal analysis in accordance with recommendations in the letter to EPA dated November 23, 1994, which EPA approved. The following text provides a summary of the analytical procedures, which are also noted in Table 2.7-9.

Mouse tissue samples for cadmium and zinc were prepared for analysis by EPA method 200.3. Cadmium and zinc concentrations were analyzed using EPA method 200.9 and 200.7, respectively. The use of these procedures represents a departure from the EQAPjP, which specified AOAC analytical methodologies. The EFSP specified quantitation limit of 0.005 mg/kg for these COPCs could not be attained and was, therefore, raised to 0.01 mg/kg. Both fluoride whole body and femur samples were prepared using AOAC methodology 3.085. The exception to the methodology detailed in the EFSP was:

For cadmium and zinc analyses, digestion was performed by EPA method 200.3 and analysis was performed by EPA method 200.7 for zinc and EPA method 200.9 for cadmium, rather than AOAC methods specified in the EFSP. The EFSP specified quantitation limit of 0.005 mg/kg could not be reached by these methods and was raised to 0.01 mg/kg.

Surface and Subsurface Characterizations
Tables for Section 2.7

TABLE 2.7-1
LOCATIONS OF AQUATIC STUDY SITES

Habitats	Study Sites	Location
IWW Ditch Outfall	Portneuf River upstream of the IWW ditch outfall[a]	Previously identified as Sampling Station #21.
	Portneuf River at the IWW ditch outfall	Within 20 meters downstream of the confluence of the IWW ditch outfall and the Portneuf River. Previously identified as Sampling Station #17.
	Portneuf River downstream of the IWW ditch outfall	Previously identified as Sampling Station #16.
Portneuf River Delta at American Falls Reservoir	Portneuf River Delta above the high water line.	4 stations at approximately 1 km intervals (the two most upstream stations located 0.5 km and 1.0 km from location previously identified as Station "C")
	Portneuf River Delta at American Falls Reservoir	6 locations at approximately 1 km intervals to a distance of 10 km downstream from Station 10.
	Snake River Delta above the high water line[a]	4 locations at approximately 1 km intervals
	Snake River Delta[a]	6 locations at approximately 1 km intervals

[a] Reference areas.

TABLE 2.7-2
IWW DITCH OUTFALL STUDIES
QUALITY ASSURANCE OBJECTIVES

Parameter	Method[a]	Matrix	Quantitation Limit[b]
Aluminum, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	20 µg/g
Ammonia	EPA 350.1	Sediment	0.1 mg N/l
Antimony, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	6 µg/g
Arsenic, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	1 µg/g
Barium, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	20 µg/g
Beryllium, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	0.5 µg/g
Boron, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	1 µg/g
Cadmium, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	0.5 µg/g
Calcium, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	100 µg/g
Chromium, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	1 µg/g
Cobalt, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	5 µg/g
Copper, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	2 µg/g
Fluoride	ASA 26-4.3.4 for digestion and distillation and EPA 340.3 for analysis	Sediment	10 µg/g
Iron, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	10 µg/g
Lead, total	EPA SW846-3050A for digestion and EPA 6010/7421 for analysis	Sediment	0.3 µg/g

TABLE 2.7-2 *(continued)*
IWW DITCH OUTFALL STUDIES
QUALITY ASSURANCE OBJECTIVES

Parameter	Method[a]	Matrix	Quantitation Limit[b]
Magnesium, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	100 µg/g
Manganese, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	2 µg/g
Mercury, total	EPA SW846-3050A for digestion and EPA 6010/7841 for analysis	Sediment	0.1 µg/g
Molybdenum, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	5 µg/g
Nickel, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	4 µg/g
Potassium, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	100 µg/g
Selenium, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	0.5 µg/g
Silver, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	0.5 µg/g
Sodium, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	100 µg/g
Thallium, total	EPA SW846-3050A for digestion and EPA 6010/7421 for analysis	Sediment	5 µg/g
Vanadium, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	5 µg/g
Zinc, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	2 µg/g
Total organic carbon (TOC)	EPA SW846-9060	Sediment	1% DW
Particle size distribution	ASTM D 422-63	Sediment	NA
AVS Sulfide[c]	EPA SW846 Method 6010	Sediment	0.01 µmoles/g

TABLE 2.7-2 *(continued)*
IWW DITCH OUTFALL STUDIES
QUALITY ASSURANCE OBJECTIVES

Parameter	Method[a]	Matrix	Quantitation Limit[b]
SEM Cadmium[c]	EPA SW846 Method 6010	Sediment	0.01 µmoles/g
SEM Copper[c]	EPA SW846 Method 6010	Sediment	0.01 µmoles/g
SEM Nickel[c]	EPA SW846 Method 6010	Sediment	0.01 µmoles/g
SEM Lead[c]	EPA SW846 Method 6010	Sediment	0.01 µmoles/g
SEM Zinc[c]	EPA SW846 Method 6010	Sediment	0.01 µmoles/g
SEM Total[c]	EPA SW846 Method 6010	Sediment	0.01 µmoles/g
Toxicity	ASTM E 1383-93[d]	Sediment	NA

(a) Methods: ASTM methods are from ASTM (1990) or ASTM (1993); AOAC methods are from AOAC (1990); EPA SW methods are from EPA (1986); and other EPA methods are from EPA (1983).

(b) The requested quantitation limits were set below the known or suspected analyte concentrations in the matrices being analyzed and are within the capabilities of the listed methods.

(c) AVS/SEM = Acid volatile sulfide and simultaneously extracted metals.

(d) 10-day test with the midge *Chironomus tentans* and 10-day test with the amphipod *Hyalella azteca*.

Key:

NA = Not applicable.
DW = Dry weight.
N = ammonia as nitrogen

TABLE 2.7-3
AQUATIC SAMPLING STATION LOCATIONS

Station	Date	Latitude	Longitude	Elevation (ft)
Portneuf 1	10/24/94	42 57' 36"	112 36' 40"	4453
Portneuf 2	10/24/94	54 57' 49"	112 36' 14"	4589
Portneuf 3	10/25/94	42 57' 51"	112 35' 52"	4356
Portneuf 4	10/25/94	42 58' 10"	112 35' 48"	4371
Portneuf 5	10/25/94	42 58' 23"	112 35' 29"	4343
Portneuf 6	10/25/94	42 58' 09"	112 34' 48"	5166
Portneuf 7	10/26/94	42 57' 54"	112 34' 24"	4420
Portneuf 8	10/26/94	42 57' 44"	112 34' 13"	4300
Portneuf 9	10/26/94	42 33' 37"	112 33' 47"	4351
Portneuf 10	10/26/94	42 57' 31"	112 33' 23"	4387
Snake 1	10/27/94	43 00' 16'	112 42' 34"	4360
Snake 2	10/27/94	43 00' 30"	112 41' 57"	4292
Snake 3	10/27/94	43 00' 35"	112 41' 30"	4656
Snake 4	10/28/94	43 00' 49"	112 41' 32"	4376
Snake 5	10/28/94	43 01' 18"	112 40' 32"	4590
Snake 6	10/28/94	43 01' 05"	112 40' 06"	4212
Snake 7	10/28/94	43 00' 54"	112 39' 53"	4464
Snake 8	10/29/94	43 01' 40"	112 39' 03"	4564
Snake 9	10/29/94	43 01' 36"	112 38' 40"	4391
Snake 10	10/29/94	43 01' 32"	112 37' 53"	4337

TABLE 2.7-4
RIVER DELTA STUDIES
QUALITY ASSURANCE OBJECTIVES

Parameter	Method[a]	Matrix	Quantitation Limit[b]
Aluminum, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	20 mg/kg
Arsenic, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	1 mg/kg
Cadmium, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	0.5 mg/kg
Fluoride	ASA 26-4.3.4 for digestion and distillation and EPA 340.3 for analysis	Sediment	10 mg/kg
Mercury, total	EPA SW846-3050A for digestion and EPA 6010/7841 for analysis	Sediment	0.1 mg/kg
Iron, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	10 mg/kg
Selenium, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	0.5 mg/kg
Zinc, total	EPA SW846-3050A for digestion and EPA 6010/7471 for analysis	Sediment	2 mg/kg
Total Organic Carbon (TOC)	EPA SW846-9060	Sediment	1% DW
Particle size distribution	ASTM D 422-63	Sediment	NA
AVS Sulfide[c]	EPA SW846 Method 6010	Sediment	0.01 µmoles/g
SEM Cadmium[c]	EPA SW846 Method 6010	Sediment	0.01 µmoles/g
SEM Copper[c]	EPA SW846 Method 6010	Sediment	0.01 µmoles/g
SEM Mercury[c]	EPA SW846 Method 6010	Sediment	0.01 µmoles/g
SEM Nickel[c]	EPA SW846 Method 6010	Sediment	0.01 µmoles/g
SEM Lead[c]	EPA SW846 Method 6010	Sediment	0.01 µmoles/g

TABLE 2.7-4 *(continued)*
RIVER DELTA STUDIES
QUALITY ASSURANCE OBJECTIVES

Parameter	Method[(a)]	Matrix	Quantitation Limit[(b)]
SEM Zinc[(c)]	EPA SW846 Method 6010	Sediment	0.01 µmoles/g
SEM Total[(c)]	EPA SW846 Method 6010	Sediment	0.01 µmoles/g

(a) Methods: ASTM methods are from ASTM (1990) or ASTM (1993); AOAC methods are from AOAC (1990); EPA SW methods are from EPA (1986); and other EPA methods are from EPA (1983).

(b) The requested quantitation limits were set below the known or suspected analyte concentrations in the matrices being analyzed and are within the capabilities of the listed methods.

(c) AVS/SEM = Acid volatile sulfide and simultaneously extracted metals

Key:

DW = Dry weight
NA = Not Applicable

TABLE 2.7-5
OVERVIEW OF HABITAT AND SAMPLE MATRICES

Habitats	Sample Matrices
Terrestrial - Sagebrush steppe	Surface soil
	Big Sagebrush (*Artemisia tridentia*) - foliage (current annual growth)
	Thickspike Wheatgrass (*Elymus lanceolatus*)- foliage and stems
	Deer Mouse (*Peromyscus maniculatus*) - whole organism and skeleton
Terrestrial - Riparian	Surface soil
	Russian Olive (*Elaeagnus angustifolia*) - fruit

TABLE 2.7-6
OVERVIEW OF COPCs AND SAMPLE MATRICES

Potentially Affected Media	Sample Matrices	COPCs	Number of Samples per Site
Soil	Surface Soils	F, Cd, Zn	10
Vegetation	Big Sagebrush - foliage	F, Cd, Zn	20[a]
	Thickspike Wheatgrass - foliage and stems	F, Cd, Zn	10
	Russian Olive - fruit	F, Cd, Zn	10
Small Mammals	Deer Mouse - whole organism	F, Cd, Zn	10 (Total)
	Deer Mouse - skeleton	F	

[a] Ten sagebrush samples were analyzed for Cd and Zn and twenty were analyzed for F. The number of samples analyzed for F was doubled because it was known from literature that the variance for F in foliage could be large.

TABLE 2.7-7
LOCATIONS OF TERRESTRIAL STUDY SITES

Habitats	Study Sites	Location
Sagebrush Steppe	Michaud Flats	Approximately 1 mile NNE of the FMC/Simplot facility on Michaud Flats, near the Portneuf River. 42° 55' 23.9" North; 112° 31' 37.2" West; 4,096 feet AMSL.
	Bannock Hills SW	Approximately 1-2 miles SW of the FMC/Simplot facility near electrical substation.
	Ferry Butte[a]	Approximately 15 miles NNE of the FMC/Simplot facility near the Blackfoot River. 43° 07' 29.4" North; 112° 29' 0.06" West; 4,358 feet AMSL.
Riparian	Portneuf River	Approximately 1 mile NNE of the FMC/Simplot facility on the Portneuf River. 42° 55' 16.0" North; 112° 31' 34.8" West; 4,208 feet AMSL.
	Snake River[a]	Approximately 15 miles NNE of the FMC/Simplot facility near the confluence of the Blackfoot and Snake rivers. 43° 07' 35.3" North; 112° 30' 44.8" West; 4,493 feet AMSL.

[a]Reference area.

TABLE 2.7-8
GLOBAL POSITIONING SYSTEM DATA FOR EMF TERRESTRIAL SITES

Site	Location in Plot	Date	Latitude	Longitude	Elevation
Bannock Hills	SE corner	9/17/94	42°53'50" N	112°32'50" W	4590
Bannock Hills	NW corner	9/17/94	42°53'43" N	112°32'52" W	4565
Bannock Hills	NW corner	9/17/94	42°53'43" N	112°32'52" W	4563
EMF Flats	NE corner	9/18/94	42°55'25" N	112°31'40" W	4393
EMF Flats	NE corner	9/22/94	42°55'25" N	112°31'39" W	4425
EMF Flats	SE corner	9/22/94	42°55'21" N	112°31'33" W	4395
EMF Flats	SE corner	9/22/94	42°55'21" N	112°31'33" W	4426
Ferry Butte	NW corner	9/19/94	43°07'34" N	112°29'12" W	4526
Ferry Butte	NW corner	9/22/94	43°07'34" N	112°29'12" W	4434
Ferry Butte	SE corner	9/22/94	43°07'30" N	112°29'09" W	4542
Portneuf Riparian	N end	9/19/94	42°55'17" N	112°31'39" W	4349
Portneuf Riparian	S end	9/20/94	42°55'08" N	112°31'23" W	4380
Snake Riparian	E end	9/22/94	43°07'33" N	112°30'53" W	4366
Snake Riparian	W end	9/22/94	43°07'20" N	112°31'18" W	4393
Reading @ Bench Mark #1	County Fair grounds	9/18/94	42°55'01" N	112°26'11" W	4628
Actual Location @ Bench Mark #1	County Fair grounds		42°55'00" N	112°26'07.7" W	4658

TABLE 2.7-9
TERRESTRIAL STUDIES
QUALITY ASSURANCE OBJECTIVES

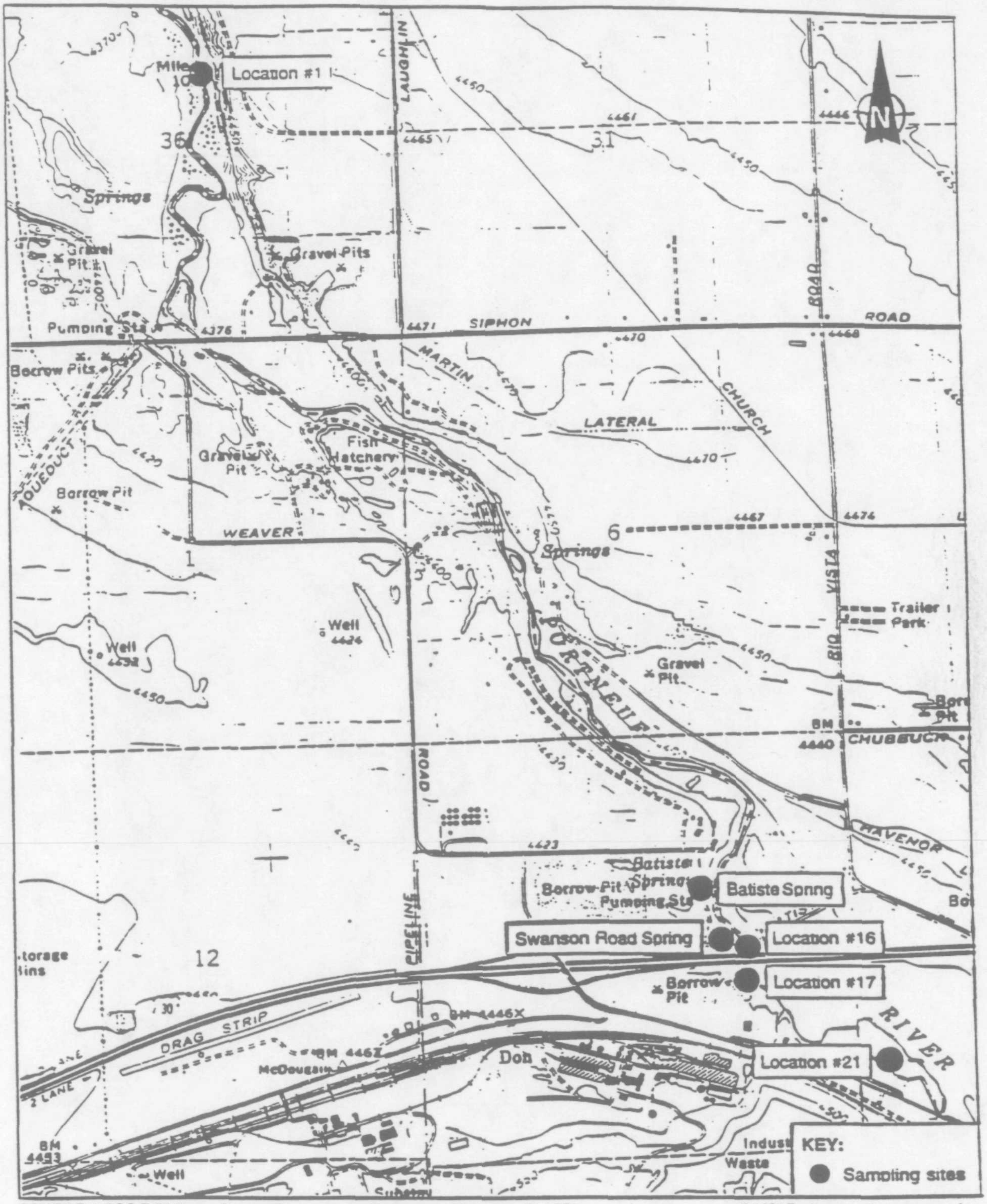
Parameter	Method[(a)]	Matrix	Quantitation Limit[(b)]
Fluoride	ASA 26-4.3.4 for digestion and distillation and EPA SW846-8010A for analysis	Soil	10 µg/g
Cadmium	EPA SW846-3050A for digestion and EPA SW846-6010A for analysis	Soil	0.1 µg/g
Zinc	EPA SW846-3050A for digestion and EPA SW846-6010A for analysis	Soil	1.0 µg/g
Soluble cations (Ca, Fe, Mg, Na, K)	Cold-water extraction and EPA SW846-6010A for analysis	Soil	1.0 µg/g
pH	EPA SW846-9045	Soil	NA
Total organic carbon	EPA SW846-9060	Soil	0.1%
Cation exchange capacity	EPA SW846-9081	Soil	0.5 mg/100g
Fluoride	AOAC Method 3.085 for preparation and 3.087 for analysis	Vegetation	10 µg/g
Cadmium	EPA SW846-3050A for digestion and EPA SW846-6010 for analysis	Vegetation	0.01 µg/g
Zinc	EPA SW846-3050A for digestion and EPA SW846-6010 for analysis	Vegetation	1 µg/g
Fluoride	AOAC Method 3.085 for preparation and 3.087 for analysis	Small mammals	1 µg/g
Cadmium	EPA 200.3 for preparation and EPA 200.9 for analysis	Small mammals	0.01 µg/g
Zinc	EPA 200.3 for preparation and EPA 200.7 for analysis	Small mammals	1 µg/g

(a) Methods: ASA methods are from ASA (1982); AOAC methods are from AOAC (1984); EPA SW methods are from EPA (1986); and other EPA methods are from EPA (1983).

(b) The requested quantitation limits were set below the known or suspected analyte concentrations in the matrices being analyzed and are within the capabilities of the listed methods.

NA = not applicable

Surface and Subsurface Characterizations
Figures for Section 2.7



SOURCE: USGS 7.5 Minute Series (Topographic) Quadrangle: Michaud, ID. 1971.

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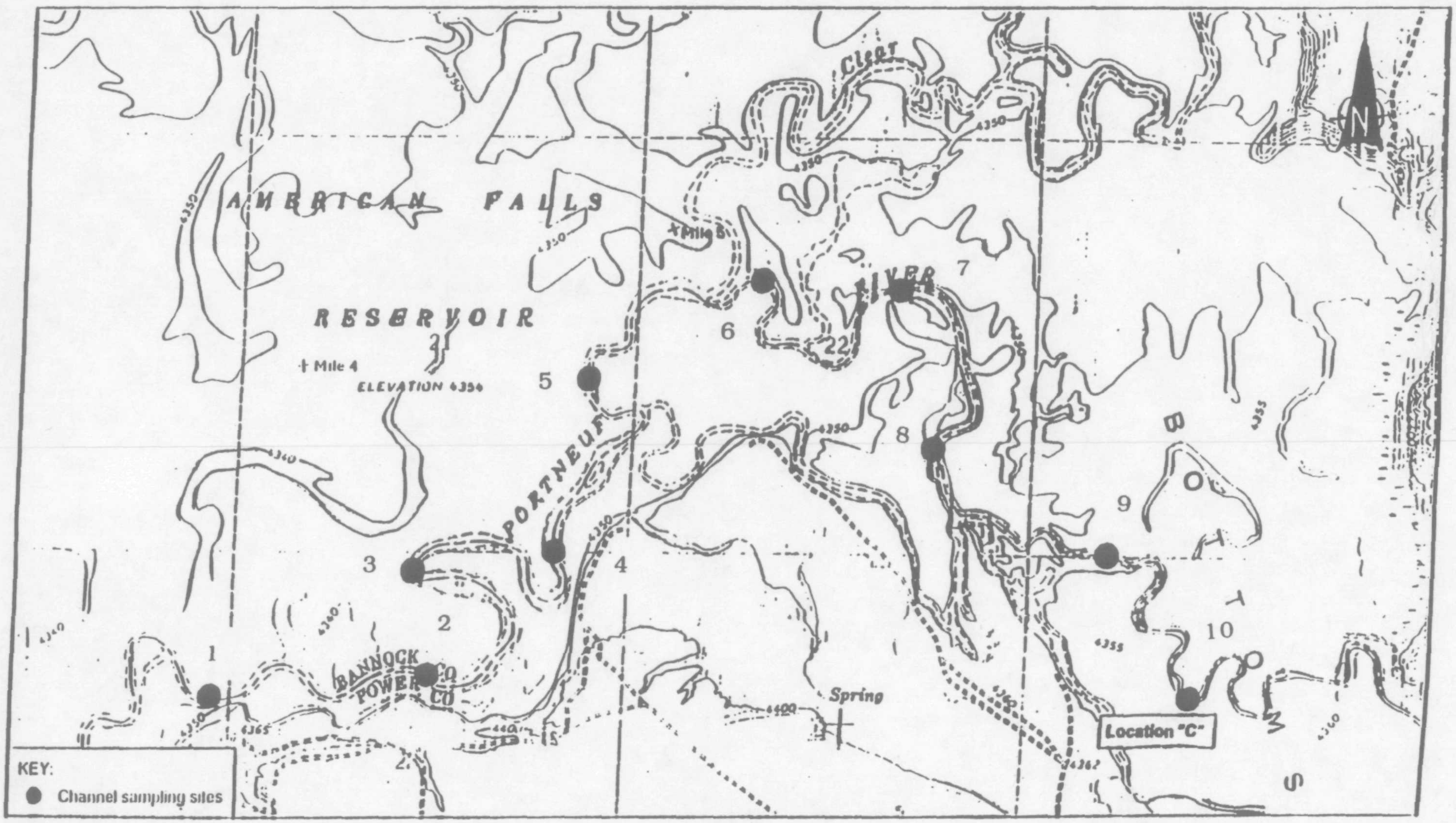
SCALE 1:24,000

0 ½ 1 Mile

0 .5 1 Kilometer

Figure 2.7-1 PORTNEUF RIVER SAMPLING STATIONS



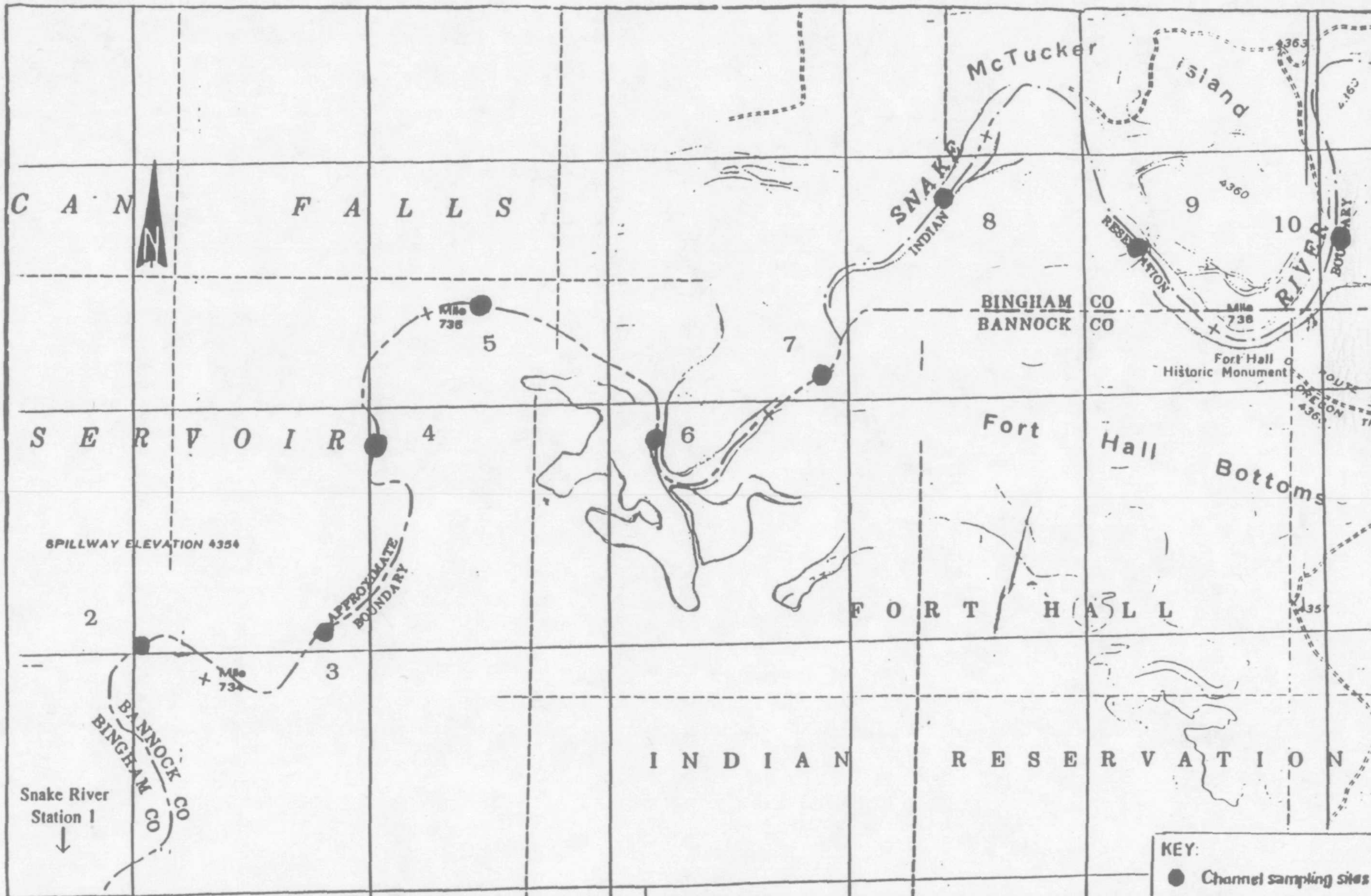
SOURCE: USGS 7.5 Minute Series (Topographic) Quadrangle: Michaud, ID 1971.

SCALE 1:24,000

0 ½ 1 Mile

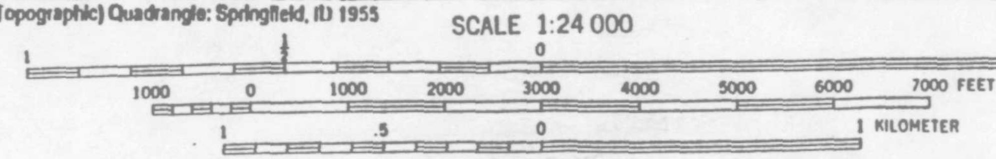
0 .5 1 Kilometer

Figure 2.7-2 PORTNEUF RIVER DELTA SAMPLING SITES

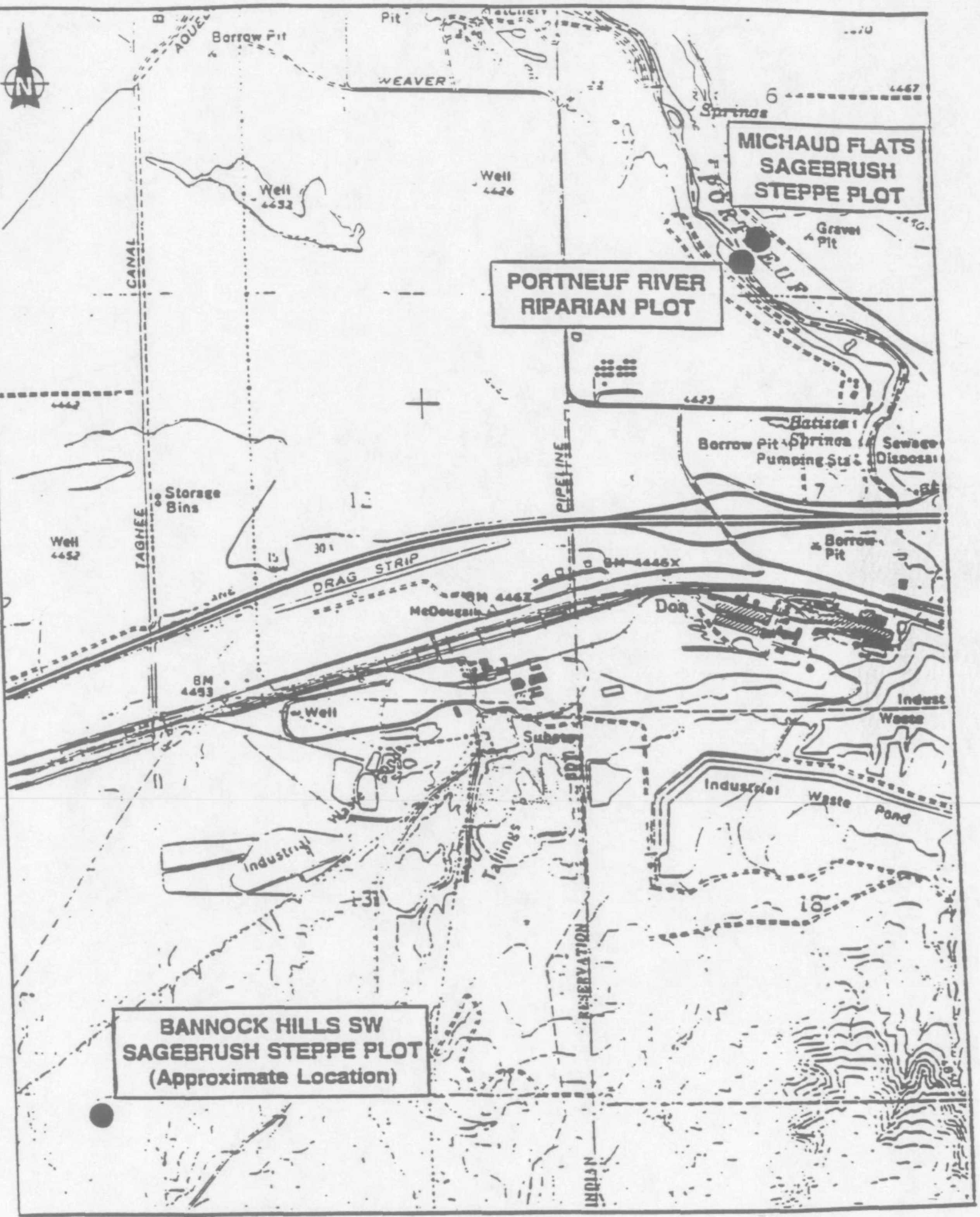


SOURCE: USGS 7.5 Minute Series (Topographic) Quadrangle: Springfield, ID 1955

SCALE 1:24 000



SNAKE RIVER DELTA SAMPLING SITES



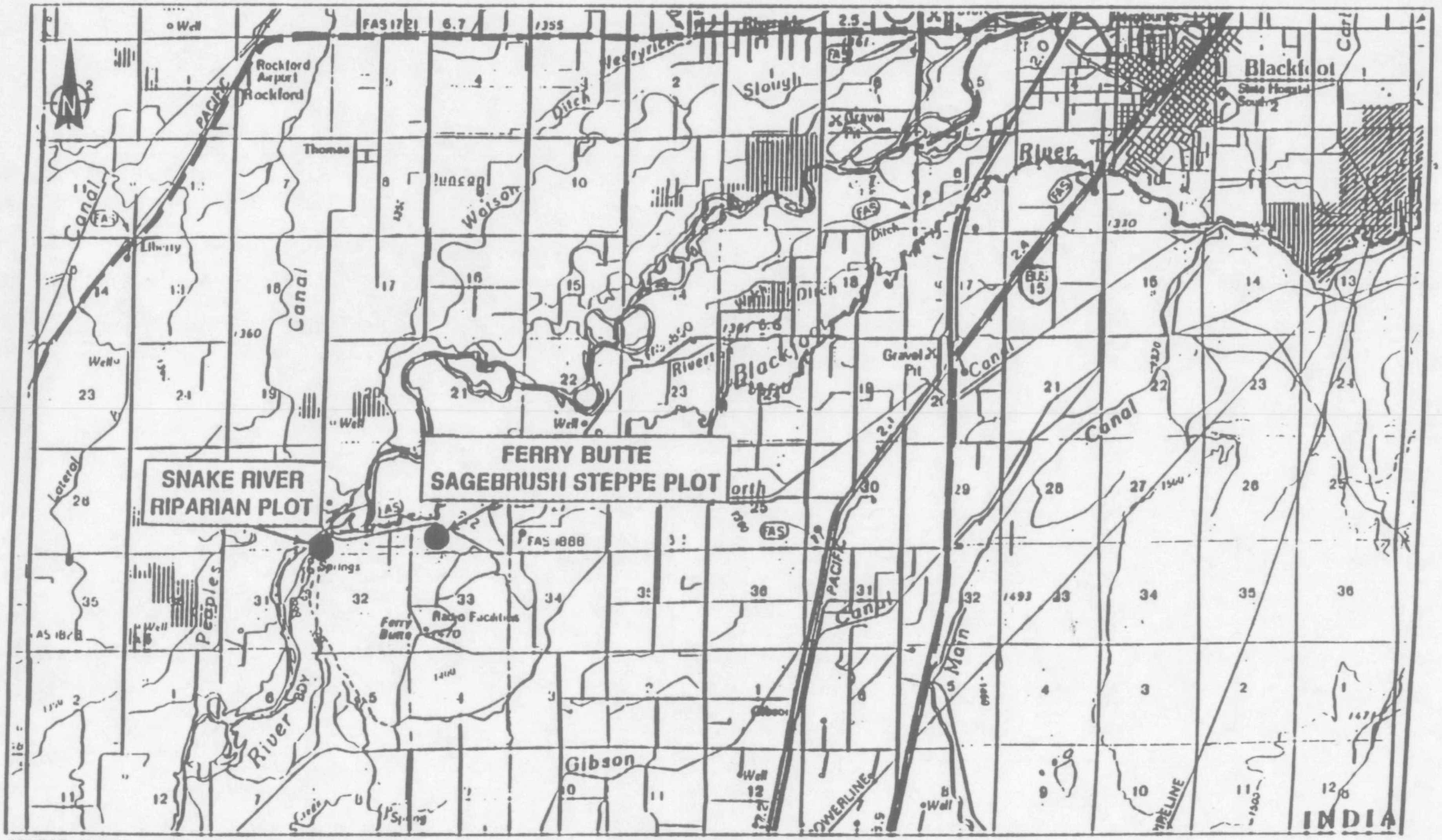
SOURCE: USGS 7.5 Minute Series (Topographic) Quadrangle: Michaud, ID 1971. Photoinspected 1974.

SCALE 1:24,000

0 1/2 1 Mile

0 .5 1 Kilometer

Figure 2.7-4 POTENTIALLY IMPACTED TERRESTRIAL SAMPLING POINTS



SOURCE: USGS Topographic Quadrangle: Blackfoot, ID 1991.

SCALE 1:100,000

0 1 2 3 4 Miles

0 1 2 3 4 Kilometers

Figure 2.7-5 TERRESTRIAL SAMPLING REFERENCE PLOTS

Physical, Demographic, and Ecological Characteristics

This section describes the physical setting of the EMF study area. Information presented here is derived primarily from data gathered as part of the RI. In addition, a significant body of previously completed work exists that describes specific aspects of the geology, hydrogeology, hydrology, land use, and ecology of the EMF study area. Where appropriate, information from these studies has been incorporated into this section.

This section discusses the following characteristics of the study area:

- Section 3.1 describes regional and site geology (including local stratigraphy).
- Section 3.2 describes the characteristics of the regional surface water hydrology, including characteristics of the Portneuf River and American Falls Reservoir, sediment deposition, and site runoff.
- Section 3.3 describes the occurrence of groundwater and groundwater flow characteristics, and summarizes the groundwater system and conceptual model.
- Section 3.4 describes the soil types and distributions.
- Section 3.5 addresses the area climate.
- Section 3.6 discusses regional demographics and potential receptors, in addition to surrounding land use.
- Section 3.7 summarizes the ecological characteristics in terms of terrestrial and aquatic ecosystems, and identifies sensitive species and habitat.

The information presented in this section, along with information on sources of constituents of potential concern presented in Section 1, provides a context in which to interpret the potential source, soil, groundwater, surface water, sediment, and ecological data summarized in Section 4.

3.1 GEOLOGY

Previous investigations conducted in the EMF study area provide a regional description of the underlying and surrounding geology. This information is summarized in Section 3.1.1. Site-specific geology, including a description of the local stratigraphy, is summarized in Section 3.1.2. The results of thermal and gamma geophysical logging are presented in Section 3.1.3. An overview of EMF study area geology is presented in Figure 3.1-1.

The EMF study area is located at the base of the northern slope of the Bannock Range, where it merges with the Snake River Plain. The northern part of the EMF study area is located at the southeastern edge of Michaud Flats. The southern part extends onto the north slope of the Bannock Range.

The stratigraphy of the study area can be generally described as discontinuous layers of unconsolidated sediments deposited on an erosional surface that was incised in volcanic bedrock. The sedimentary unit immediately above the bedrock is a gravel derived from volcanic rocks.

Overlying the gravel are varying thicknesses of fine-grained silts, clays, and sands that form a discontinuous, semi-confining unit. The fines are overlain by another coarse-grained unit, called Michaud Gravel, that consists of quartzite, chert, and volcanic gravels, cobbles, and boulders.

Above the second gravel unit is another fine-grained facies that consists of interfingered silts, clays, and sands. In the western part of the EMF study area, a separate but discontinuous third coarse-grained layer is present. Finally, deposits of windblown silt (loess) and a colluvial silt and gravel layer of variable thickness mantle the area. The loess layer ranges from 2 to over 100 feet (0.6 to 30 m) thick at the EMF facilities, and is calcareous. To the north and east, the Michaud Gravel occurs in scoured channels. The fine-grained layers present in the western and central areas of the facilities are generally absent here.

A more detailed description of the regional and local geological features in the EMF study area is presented in the following pages.

REGIONAL GEOLOGY (SECTION 3.1.1):	• EMF study area is located within the Bannock Range and the Snake River Plain (Michaud Flats). • Shallow stratigraphic units where the Michaud Flats merges with the Bannock Range includes interbedded and reworked volcanics of the Starlight Formation, primarily interfingered with the Sunbeam Formation. These are, in general, overlain by Michaud and Aberdeen Terrace gravels. Recent alluvial deposits and loess mantle these older units to varying degrees.
SITE GEOLOGY (SECTION 3.1.2):	• Southern part of study area at higher elevations is characterized by loess deposits, colluvium, and volcanic gravels overlying bedrock. • Central and northern parts of study area are, in general, loess, and quartzitic Michaud Gravel overlying or incised into underlying silt and clay units of the American Falls Lake Beds. Deeper gravels are volcanics derived from Bannock Range. • Area north and east of Simplot is underlain by very coarse Michaud Gravels with little or no interbedded fine-grained units.
GEOPHYSICAL LOGGING RESULTS (SECTION 3.1.3):	• Temperature logging does not indicate the presence of geothermal waters beneath EMF study area. • Gamma log results support conclusion that volcanic bedrock contains a relative abundance of naturally occurring radioactive material, whereas Michaud Gravel does not. However, areas of fill in the EMF study area were recognizable by their gamma spikes.

FIGURE 3.1-1
OVERVIEW OF GEOLOGY

3.1.1 REGIONAL GEOLOGY

The EMF study area is located at the juncture between two major physiographic provinces (Dohrenwend, 1987): the Basin and Range province (Bannock Range) to the south and the Snake River Plain (Michaud Flats) to the north.

The Basin and Range province is a major physiographic province of North America, extending from eastern California across Nevada into Utah and from Oregon and Idaho into New Mexico and Mexico. The Basin and Range province is characterized by relatively evenly spaced, subparallel, north- to northwest-trending mountain ranges and intervening basins formed by high-angle extensional faulting, active mainly in mid to late Tertiary time.

The Snake River Plain is a 70- by 200-mile (112- by 32-km) Quaternary valley, filled to a depth of more than 10,000 feet (3,050 m) with volcanic rocks and intercalated volcanic-derived sediments (Whitehead, 1986). Being a younger structural feature, it bisects the northern portion of the Basin and Range province, isolating Basin and Range structures north of the Snake River Plain. The Snake River plain extends from Yellowstone Park in a broad southwest-trending arc (Stearns et al., 1938). The Snake River flows close to the southeastern margin of the Snake River Plain. Since the EMF study area is situated on the eastern portion of the Snake River Plain, all subsequent references to the Snake River Plain relate only to the eastern portion.

The Michaud Flats is a portion of the Snake River Plain north and west of Pocatello, Idaho. The EMF study area lies at the southeastern margin of Michaud Flats, about 3 miles (5 km) northwest of Pocatello. The Michaud Flats is a roughly elliptical area about 9 miles (14 km) long and 5 miles (8 km) wide, bounded on the west by Bannock Creek, on the north by American Falls Reservoir, on the east by the Portneuf River, and on the south by the Bannock Range (USGS, 1984).

The general geology in the vicinity of the EMF study area is shown in Figure 3.1-2 (a and b). Site topography is presented in Figure 3.1-3. Stratigraphy and geologic history are presented from oldest strata to youngest, and draw from Trimble's USGS Professional Paper 1400 (1976). Briefly, the stratigraphic sequence, from oldest to youngest, is summarized as follows: Precambrian basement metamorphic and marine sedimentary rocks, minor local occurrences of Paleozoic rocks, widespread Tertiary volcanics, and Pleistocence to Recent alluvial, lacustrine, and eolian deposits.

The Bannock Range, and probably the Snake River Plain, are underlain by a basement complex of Precambrian to Cambrian metamorphosed to unmetamorphosed marine sedimentary and volcanic rocks [older than 570 million years ago (Ma) to 505 Ma] (Ludlum, 1942 and 1943). Rocks representing the next 500 Ma are absent from the region except for localized Paleozoic rocks outcropping in the northern Pocatello Range (Figure 3.1-2a).

Compressional folding and thrusting occurred as recently as 66 Ma, when large thin plates of basement complex rocks were thrust eastward on low-angle faults. Such rocks are found exposed about 3 miles (4.8 km) south of the EMF study area in the Bannock Range, and are part of a 6,000-square-mile (15,400-square-km) thrust sheet that extends southward to Ogden, Utah. The crustal compression also caused regional uplift, resulting in extensive erosion and a regional unconformity.

The erosional surface was disrupted when crustal extension caused block faulting and created the Basin and Range province (Trimble, 1976; Peterson, 1988). Basin and Range deformation began 35 Ma, peaked approximately 17 to 14 Ma, and continues episodically through the present (Dohrenwend, 1987).

Structurally, the Bannock and Pocatello ranges constitute a single block of the Basin and Range. A north-trending, down-to-the-west fault or series of faults of large but unknown displacement is on the west side of the Bannock Range. The age of major movement is older than about 10 Ma (Trimble, 1976 and Kellogg, 1992). These faults occur about 3 miles (4.8 km) south of the study area.

The known fault closest to the site is a short northeast-trending fault more than a mile south of the EMF study area (Trimble, 1976). The fault apparently does not continue north toward the study area, as it is not identified in deposits exposed immediately north of the fault.

The Snake River Plain was formed by a downward movement of the earth's crust where the crust is effectively cut by faults; the block of crust that drops down is a graben. Faults bounding this graben run across the north-south trending structures of the Basin and Range province. Therefore, the Snake River Plain truncates, or cuts across, Basin and Range structures. Graben development was accompanied by volcanism and caldera subsidence beginning 12 to 2 Ma, depending on the location. The volcanoes provided large amounts of ash, lava, and debris, filling the valley as the crust moved downward. Near the EMF site, the Picabo volcanic center was active about 10 Ma (Pierce and Morgan, 1992). The Picabo field produced voluminous silicic lavas and pyroclastic debris, including ignimbrite deposits, ash tuffs, welded tuffs, and rhyolitic flows.

In the vicinity of the EMF study area, volcanic rocks and sediments are called the Starlight Formation and originate from the Picabo eruptions (Trimble, 1976). The Starlight Formation was divided into three members (Trimble, 1976):

- A lower member of mostly nonporphyritic basalt flows with basaltic tuff and breccia, bedded rhyolitic tuff, marl, claystone, gravel, and conglomerate
- A relatively thin middle member of welded to unwelded rhyolitic ash flow tuffs
- An upper member of bedded rhyolitic tuff capped in the immediate vicinity of the EMF site by a porphyritic trachyandesite (latite porphyry)

In addition, Trimble (1976) described a younger rhyolite deposited in late Pliocene to early Pleistocene time (about 1.6 Ma). For this investigation, no distinction is made between Starlight Formation members.

In more recent geologic time, a different type of volcanism occurred in the Snake River Plain. These are the Pleistocene basalt flows. In the Portneuf River Valley and along the Snake River are the following late Pleistocene basalt flows: the Big Hole Basalt; the Cedar Butte Basalt; and the basalt of the Portneuf River Valley (about 33,000 years old; Trimble, 1976).

The Cedar Butte Basalt dammed the Snake River near American Falls, forming an ancient lake that extended up to the Bannock Range foothills in the EMF study area (Stearns et al., 1938). The ancient lacustrine sediments were named the American Falls Lake Beds by Carr and Trimble (1963) and are mostly clay with minor silt, sand, and localized gravel.

The Sunbeam Formation was deposited at roughly the same time as the American Falls Lake Beds. The Sunbeam Formation includes the stream, floodplain, and delta deposits surrounding the ancient lake.

The lake bed deposits are interbedded with the coarser fluvial and deltaic strata of the Sunbeam Formation. Lacustrine and subaerial deposits are difficult to delineate at the lake margins due to fluctuating lake levels, meandering stream channels, and variable sediment supply.

Pediment gravels which are exposed to the southeast of the site (Figure 3.1-2a) were described by Trimble (1976) as gravel and rubble deposits several miles wide mantling pediment surfaces cut on Tertiary rocks at the mountain fronts of the Bannock and Pocatello ranges. The gravel and rubble deposits consist almost entirely of locally-derived basement complex rocks. Trimble (1976) interprets the age of the pediment gravel deposits to be late Pleistocene, and older than the Big Hole Basalt but younger than the American Falls Lake Beds.

About 15,000 years ago, a catastrophic flood from ancient Lake Bonneville in northern Utah flowed down the Portneuf River Valley onto the Snake River Plain and into the basalt-dammed lake (Scott et al., 1982; Houser, 1992). The divide between Lake Bonneville and the Portneuf River Valley was rapidly downcut, releasing as much as 380 cubic miles (1,560 cubic km) of water over an estimated peak-flow period of 6 weeks (Malde, 1968). The flood waters filled the ancient basalt-dammed lake, then flowed over the Cedar Butte Basalt lava dam. The flood deposited extremely coarse-grained sediments named the Michaud Gravel along the Portneuf River Valley and into the Michaud Flats (Trimble and Carr, 1961). The Michaud Gravel consists of mostly quartzite and other quartz-rich metamorphic lithologies, with minor basalt. Sediment can be exceptionally coarse in the flood channels; quartzite and basalt boulders up to 8 feet (2.5 m) in diameter occur in downtown Pocatello (Trimble, 1976).

The Aberdeen Terrace gravels were deposited on the Michaud Gravel and the American Falls Lake Beds during the waning stages of the Lake Bonneville flood (Trimble, 1976). North of the EMF study area, Aberdeen Terrace gravels occur in braided abandoned channels (shallow swales) on Michaud Flats near the Portneuf River and as blanket deposits farther west (Trimble, 1976).

The basalt dam (Cedar Butte basalt) was breached during the Bonneville Flood, thus draining the lake. The Portneuf and Snake rivers ran across the relict lake bed until construction of the American Falls Reservoir.

Late Pleistocene to Recent deposits of silt, sand, and gravel in the site vicinity were named older alluvium (Trimble, 1976). Younger alluvial deposits of silt, sand, and gravel cover the floors of major streams and other drainages. Extensive deposits of windblown silt (loess) cover the northern and western flanks of the Bannock Range and the northern portion of the Pocatello Range (Trimble, 1976). Loess was derived from the Pleistocene glaciers and is a "rock flour" that is made when glaciers scour bedrock and grind rock into very fine particles. Loess is then transported off the glaciers by winds and eventually deposited away from the glacier.

In summary, the shallow stratigraphic sequence where Michaud Flats merge with the Bannock Range includes the interbedded volcanics and reworked volcanics of the Starlight Formation, American Falls Lake Beds interfingered with the Sunbeam Formation and overlain by Michaud

Gravel, which are overlain by the Aberdeen Terrace gravels. Recent alluvial deposits and loess mantle these older units to varying degrees.

3.1.2 EMF Study Area Geology

This section presents the results of the RI drilling and geologic logging program. These results are discussed within the framework of the regional geology. Several key elements of this discussion are critical when discussing the EMF study area hydrogeology in Section 3.3.

As described in Section 3.1.1, the study area is located at the northern base of the Bannock Range, where it merges with the Snake River Plain (Figure 1.3-1). The boundary between these features is seen in a scarp that runs through the EMF facilities, with 50 to 70 feet (15 m to 21 m) of relief (Figure 1.3-1).

The Portneuf River passes northeast of the Simplot facility and Michaud Creek passes the FMC facility immediately to the west. The floodplain of the Portneuf River near the study area is approximately 0.5 mile (0.8 km) wide. The riverbed lies entrenched in the Michaud Flats at a depth of about 20 to 40 feet (6 m to 12 m). The entrenched depth increases toward the American Falls Reservoir. Several steep dry draws begin in the Bannock Range and continue northward to the flats, and occur as sediment-filled channels in the subsurface.

In general terms, the EMF study area is underlain by a sequence of Starlight Formation volcanics and sediments, overlain by the interfingered American Falls Lake Beds-Sunbeam Formation. These are overlain by Michaud Gravel and Aberdeen Terrace deposits. Finally, a mantling of loess is present at higher elevations and a veneer of alluvium covers lower areas. Loess deposits are much thicker in portions of drainages where they have been reworked and redeposited.

The Starlight Formation has three distinct members, which vary lithologically from volcanic gravels, silts, and sands to intact volcanics. Because of the marked relief on the erosional surface of the Starlight Formation, any given location can be underlain by any one of a number of Starlight lithologies. The relationship between the volcanic deposits and the overlying sedimentary deposits is conceptualized in Figure 3.1-4 and shown in greater detail in Figures 3.1-5 through 3.1-12. The upper surface of volcanic deposits can be difficult to distinguish in drill cuttings because there are places where younger Sunbeam deposits overlie similar unconsolidated Starlight Formation deposits. Inferred contours on the upper surface of the Starlight Formation and basalts are shown in Figure 3.1-13. Boring logs and well construction details are presented in Appendix B.

Basalt was encountered beneath the EMF facilities in six borings (FMC-4, TW-2D, 129, 130, 139, and 304). The basalt in boreholes 139 and 304 was encountered beneath volcanic tuffs, indicating that the basalts may be part of the Tertiary deposits. The presence of basalt in the other four borings suggests that a late Pleistocene basalt flow may exist beneath part of the FMC facility. This basalt could be a distal lobe of the Big Hole Basalt or a part of one of the many other basalt flows in the area.

The unconsolidated sediments include Sunbeam Formation-American Falls Lake Beds, Michaud Gravel, and possibly Aberdeen Terrace Deposits. These units occur as alternating intervals of coarse-grained sediments (generally sand and gravel) and relatively fine-grained sediments (clay and silt). These units are laterally correlative between borings, although they also merge and pinch out as shown in Figures 3.1-6 through 3.1-12.

Beneath the northern portion of the FMC facility, the thicknesses of both the coarse- and fine-grained intervals are relatively consistent. In the southern portion of FMC, the extent and thickness of different deposits is much more variable. Beneath the Simplot facility and near the Portneuf River, the fine-grained intervals are variable in thickness and extent. There is a transition zone near the FMC-Simplot boundary where fine-grained intervals are more numerous and considerably thinner.

Locally, relatively thick accumulations of clay occur beneath the Simplot facility near the edge of Michaud Flats (sections C-C' and D-D', Figures 3.1-8 and 3.1-9). These clay deposits are distal from incised bedrock valleys. The incised valleys are typically filled with coarser sediments. The sediment distribution relative to the bedrock valleys indicates that these valleys were waterways, depositing coarser sediments under higher energy conditions and depositing fine-grained sediments in the flats or over the banks. Near the Portneuf River, the thin, fine-grained layers pinch out or are truncated by flood deposits. The northernmost cross-section G-G' reveals a clay layer in the Michaud Flats that pinches out from west to east (Figure 3.1-12). This clay layer occurs within the saturated sediments, and acts as a local confining unit.

Many borings encountered a coarse-grained interval composed of angular volcanic gravels immediately above hard volcanic rock. These gravels are most likely derived locally and appear to be Sunbeam Formation. The overlying fine-grained interval is composed mostly of silt and clay with minor sand and gravel. This fine-grained unit may be part of the Sunbeam Formation or the American Falls Lake Beds.

The fine-grained interval identified as the American Falls Lake Beds/Sunbeam Formation is overlain by the Michaud Gravel, composed of rounded gravel, cobbles, and boulders of quartzite, chert, and volcanics. These gravels represent the Bonneville flood deposits which are relatively uniform in thickness beneath the northwestern half of the EMF facilities. The Michaud Gravel increases in thickness toward the east, truncating the underlying fine-grained interval and probably deeper units as well. The thicker deposits of the Michaud Gravel appear to be in a scoured channel confined by the Pocatello Range and Bannock Range. When the Bonneville Floods reached the Michaud Flats, the waters spread and lost energy, dropping out most of the coarsest sediments along the eastern margin of the EMF facilities and depositing finer gravels to the west.

Above the Michaud Gravel is another fine-grained/coarse-grained couplet. This couplet may be Aberdeen Terrace deposits or it may be part of the Michaud Gravel. Since the Aberdeen Terrace deposits are reworked Michaud Gravel, it is very difficult to distinguish between the two. For characterizing the geology beneath the EMF facilities, it makes little difference which name is attached to these units.

Eolian deposits of loess and fine sand mantle the lower slopes of the Bannock Range and terrace or pediment deposits near the margin of the Michaud Flats. Loess deposits are particularly thick in the lower portions of drainages, where the silty material may be reworked and redeposited (for example, Section D-D', Figure 3.1-9).

Finally, recent (Holocene Era) fluvial and alluvial sediments were deposited in and near present-day stream channels.

3.1.3 RESULTS OF GEOPHYSICAL LOGGING

Thermal and gamma geophysical logging was performed in 32 deep monitoring wells. Thermal logging was performed to determine if hydrothermal waters were present beneath the site. Hydrothermal waters are a regulated resource in the State of Idaho, and hydrothermal waters occurring in volcanic rocks may contain high levels of dissolved metals and other constituents. Thermal logging was not done until heat released during grout hydration had sufficient time to dissipate. Down-hole gamma logging was performed to augment visual field descriptions of samples and cuttings of soil and rock and to detect possible anomalous sources of radioactivity. Geophysical logs are presented in Appendix D.

Thermal logging results indicate a wide range of vertical temperature profiles. Negligible vertical temperature gradients are discernible in logs for Wells 102, 109, 133, 300, 301, 306, 307, 308, 313, 321, and 502. Although the temperature in each of these logs does not change with depth, the temperatures in the different wells range between the low 50s and mid 60s (°F) (approximately 10-14°C and 17-19°C, respectively).

Temperatures gradually decrease with depth in logs for Wells 309, 317, and 503. In several wells temperatures are as high as 70°F (21°C) and deep temperatures range between the mid 60s and mid 50s (°F) (approximately between 17-19°C and 12-14°C). The steepest temperature gradient occurs in Well 107, where shallow temperatures exceed the 86°F (30°C) limit of the logging tool, then gradually decrease with depth to the mid 60s (°F) (or to approximately 18°C). The log for Well 319 indicates temperatures of about 70°F (21°C) for the shallowest 20 feet (6 m) of water, then drops abruptly to the low 60s (°F) (approximately 15-18°C) before slowly decreasing with depth to the upper 50s (°F) (approximately 13-15°C).

Temperatures gradually increase with depth in 13 wells (117, 125, 130, 142, 144, 153, 304, 305, 315, 504, 506, 508, and 512), with an average temperature difference of 3°F between the shallow and deep wells.

None of the logs indicate natural significant geothermal gradients, and except for Well 107, none indicate temperatures greater than 70°F (21°C). The high temperature at shallow depths in Well 107 is probably due to the proximity of the furnace building and slag pit. Well 517, which is projected to be in this thermal plume, also has elevated temperatures. Most of the wells near the Portneuf River exhibit low temperatures in the low to mid 50s (approximately 12-14°C), especially in the shallower portion of the aquifer.

The log for Well 500 exhibits anomalous temperature changes that occur with depth. Logging for Well 500 was performed three days after the well was completed. The anomalous temperatures logged in Well 500 are restricted to depths above the filter pack and therefore could be due to heat released during grout hydration.

In summary, results of temperature logging do not indicate the existence of geothermal waters beneath the EMF facilities, but local thermal effects from the slag pit were evident.

Gamma logs measure the decay of radioactive elements in the subsurface. These elements are typically concentrated in clays, silts, and silicic igneous rocks from natural processes such as weathering or magmatic fractionation. Gamma logs can be used in some geologic settings to correlate geologic units when certain units contain a higher level of radioactive elements.

In the EMF study area, only weak correlations were observed in the gamma logs. In general, the fill areas showed a relative peak or spike in the gamma readings and there were minor peaks associated with some silt and clay units. There were also high gamma counts associated with the silicic volcanic bedrock of the Starlight Formation. Michaud Gravel had very low gamma signatures.

In summary, the gamma log results support the conclusion that the volcanic bedrock contains a relative abundance of naturally occurring radioactive material, whereas the Michaud Gravel does not. The silt and clay units do not contain a sufficient amount of radioactive elements to provide a consistent sharp signature on the gamma logs, reducing the resolution of the gamma logs for use in correlating these units. However, areas of fill were sometimes very recognizable by their gamma spikes. This is supported by radioactivities found in some source materials during the potential source investigation (Section 4.2).

Gamma logs and temperature logs are included with a more detailed discussion of the results in Appendix D.

Surface and Subsurface Characterizations
Figures for Section 3.1

Qam
Qam
Qal
Qm
Qm
Qam
Qm
Qm
MICHAUD FLATS
SNAKE RIVER PLAIN
PORTNEUF
Qm
Qal
Qm
POCATELLO MUNICIPAL AIRPORT
Qm
Batiste Springs
86
Qal
RIVER
SIMPLOT FACILITY
FMC FACILITY
Qal
MICHAUD CREEK
Qal
POCATELLO CR.
POCATELLO
EXPLANATION
Qal Younger Alluvium (Recent)
Loess (Upper Pleistocene and Recent)
Older Alluvium (Upper Pleistocene)
Aberdeen Terrace Deposits (Upper Pleistocene)
Qm Michaud Gravel (Upper Pleistocene) -Commonly overlain by loess
American Falls Lakebeds (Upper Pleistocene)
Pediment Gravel (Upper Pleistocene)
UNCONFORMITY
Tertiary Starlight Formation (Undifferentiated) -Late Miocene to Pliocene
UNCONFORMITY
Pre-Cambrian Basement Complex (Upper Pre- Cambrian)
Normal Fault; u, Upthrown side
EMF Property Lines
NOTE: Map adapted from Trimble, 1976
0 1 2
SCALE IN MILES
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Regional Geology
JOB No
DRAWING NO.
REV.
BECHTEL
21372
FIGURE 3.1-2a

QUATERNARY PERIOD

Holocene Epoch

Qa1	YOUNGER ALLUVIUM - sand, silt, and gravel fluvial, alluvial, colluvial, and aeolian deposits in active stream channels and mantling alluvial fans
Ql	LOESS - Aeolian deposit of silts.
Qalo	OLDER ALLUVIUM - sand, silt, and gravel fluvial, alluvial, colluvial, and aeolian deposits in abandoned channels and older terraces.

Late-Pleistocene Epoch

Qa	ABERDEEN TERRACE DEPOSITS - pebble gravel fluvial deposits of mostly reworked Michaud Gravel.
Qm	MICHAUD GRAVEL - rounded gravel, boulder, sand fluvial deposits of ancient Bonneville flood.
Qam	AMERICAN FALLS LAKE BEDS - mostly silt and clay lacustrine deposits of ancient American Falls Lake which was created by a basalt dam on the Snake River.
Qs	SUNBEAM FORMATION - mostly unbedded to poorly bedded calcareous silt, sand, and gravel alluvial and colluvial deposits surrounding ancient American Falls Lake which was created by a basalt dam on the Snake River. Not exposed in study area.
Qb	BIG HOLE BASALT - dense blue-gray to blue-black basalt deposited at about the same time as a number of other basalt flows in the region, one of which dammed the Snake River near American Falls. Not exposed in study area.
Qr	RAFT FORMATION - clay to gravel lacustrine, fluvial, and alluvial deposits related to ancient Raft Lake which was created by a basalt dam on the Snake River near the confluence of the Raft River. Not exposed in study area.
Qg	PEDIMENT GRAVELS - gravel and boulder aprons mantling pediment surfaces cut on Tertiary rock adjacent to the Bannock and Pocatello Ranges.

UNCONFORMITY

TERTIARY PERIOD

Late-Miocene to Pliocene Epoch

Tu	STARLIGHT FORMATION (undifferentiated) - mostly bedded rhyolitic tuff with interbedded ashflow, rhyolite tuff, basaltic tuff and flows, vitrophyre, trachyandesite, and sedimentary deposits including conglomerate and breccia.

UNCONFORMITY

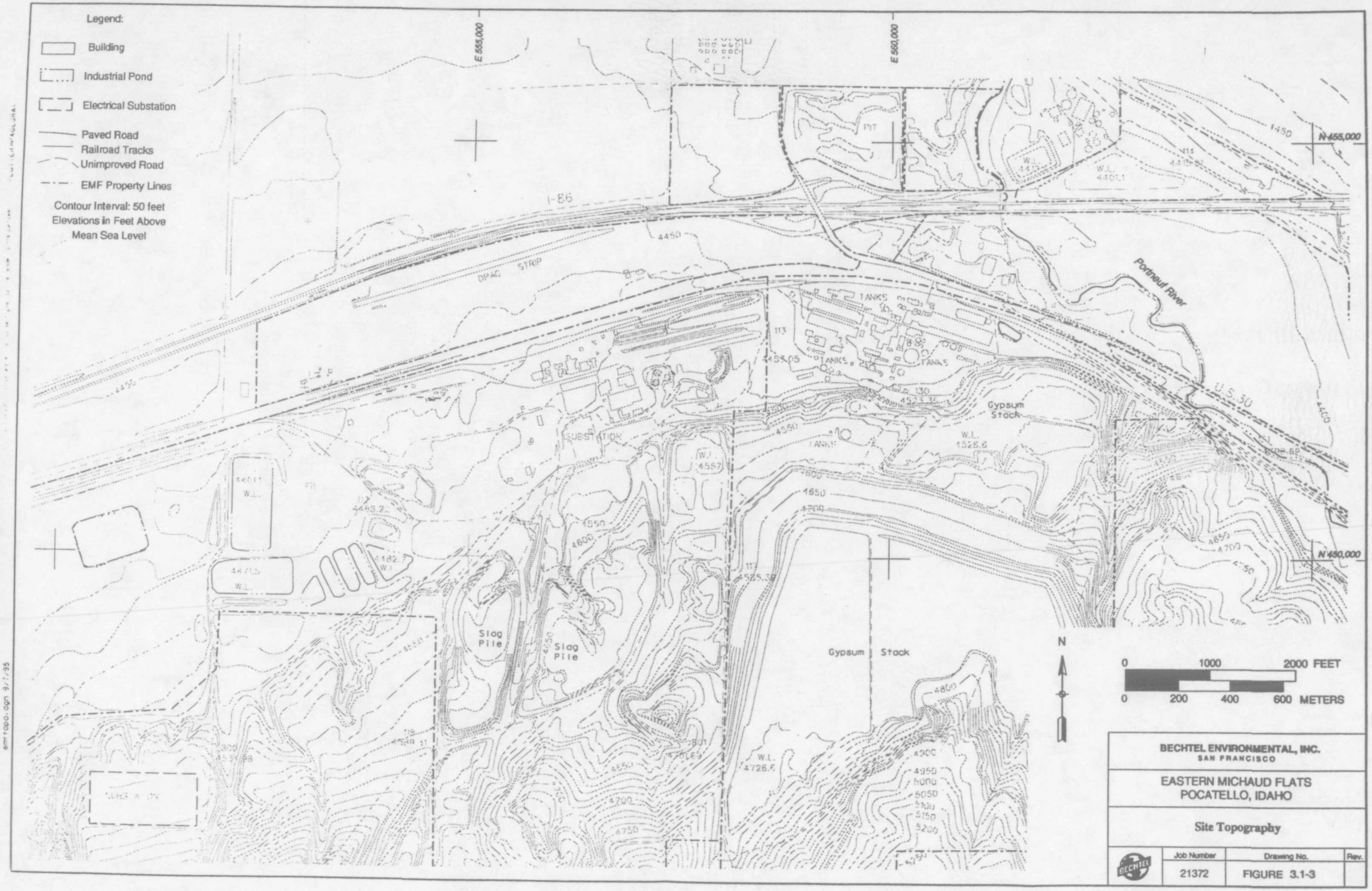
PRE-TERTIARY PERIOD

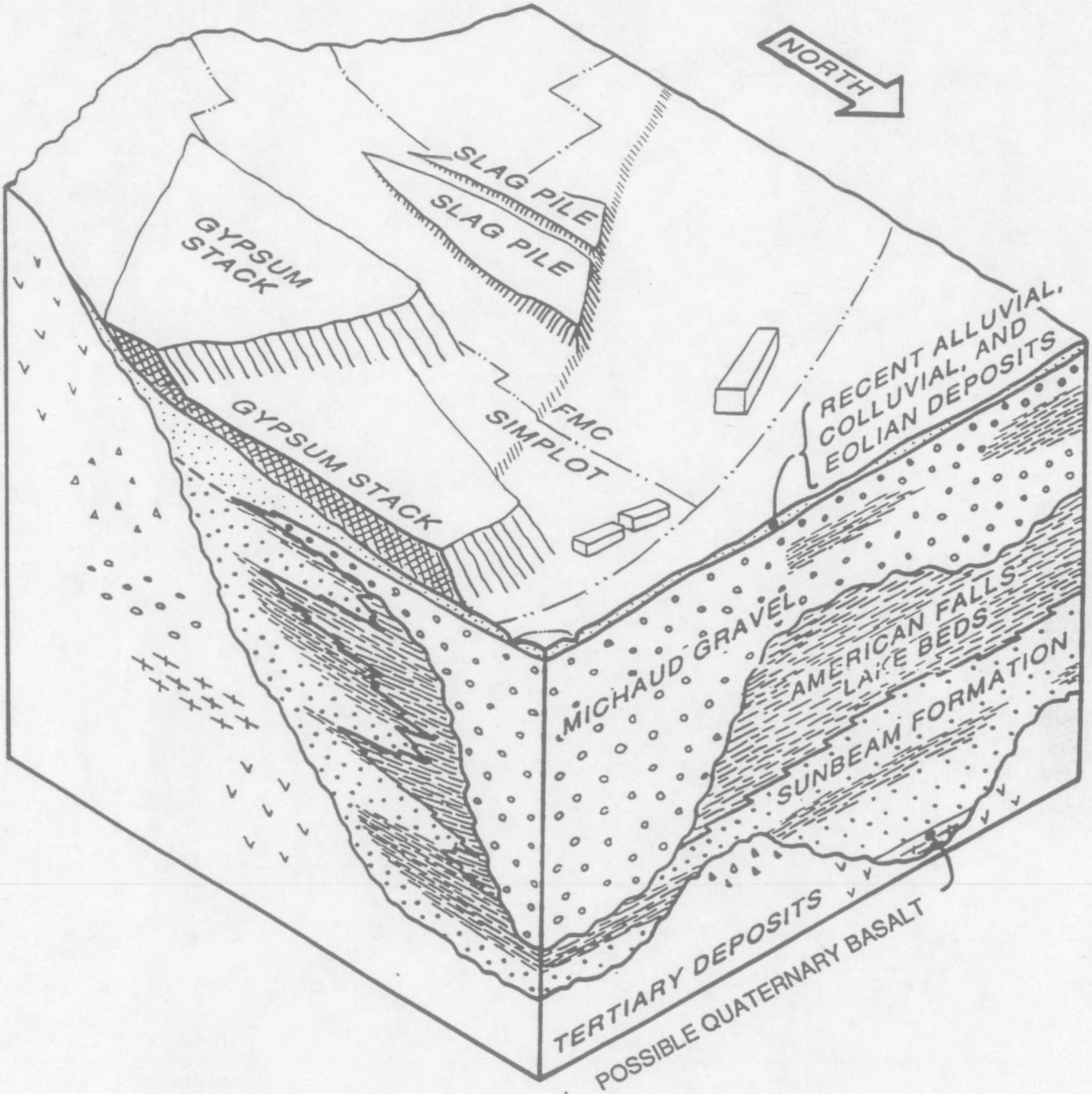
PRECAMBRIAN TO CAMBRIAN PERIOD

pCu-Cu	BASEMENT COMPLEX (undifferentiated) - metamorphosed to unmetamorphosed marine sedimentary (carbonates and fine- to coarse-grained clastics) and volcanic rocks.

93-1477c.123/DW/R0

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
EASTERN MICHAUD FLATS POCATELLO, IDAHO			
General Area Stratigraphy			
	JOB No.	DRAWING NO.	REV.
BECHTEL	21372	FIGURE 3.1-2b	


Legend:
Building
Industrial Pond
Electrical Substation
Paved Road
Railroad Tracks
Unimproved Road
EMF Property Lines
Contour Interval: 50 feet
Elevations in Feet Above
Mean Sea Level
E 555,000
E 560,000
N 455,000
N 450,000
I-86
Portneuf River
U.S. 30
PIT
TANKS
Gypsum Stack
Slag Pile
Slag Pile
SUBSTATION
Gypsum Stack
0 1000 2000 FEET
0 200 400 600 METERS
N
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Site Topography
Job Number
21372
Drawing No.
FIGURE 3.1-3
Rev.



EXPLANATION

FACILITY BUILDINGS

FACILITY PROPERTY BOUNDARIES

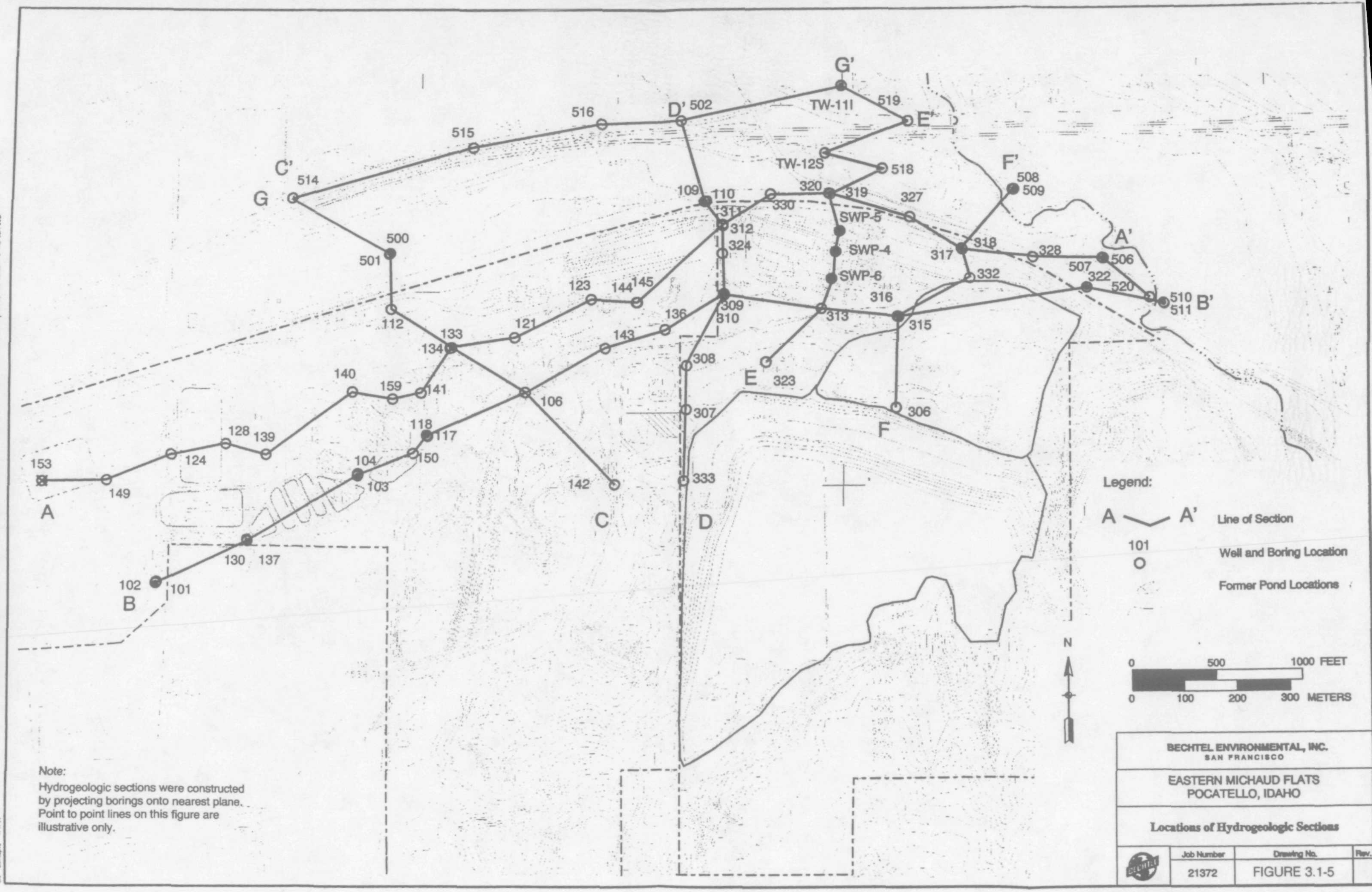
PORTNEUF RIVER

NOT TO SCALE

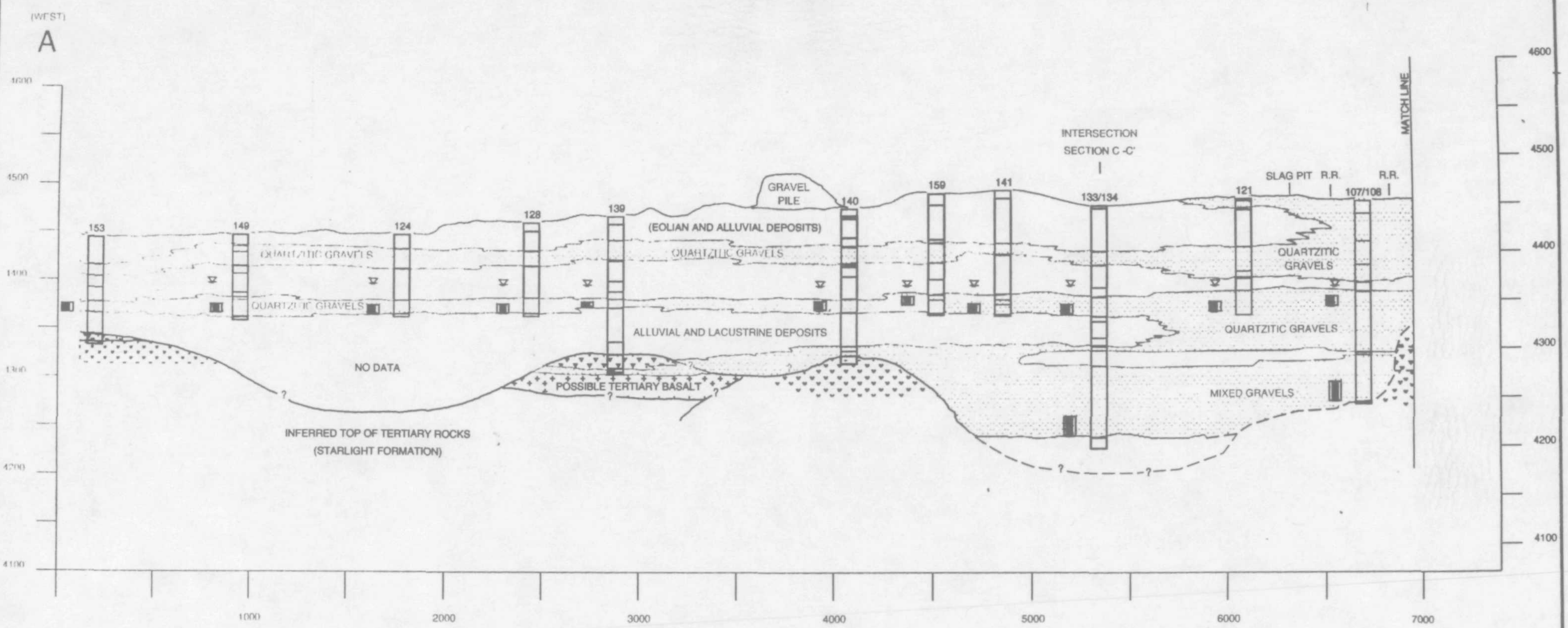
SIDES OF BLOCK REPRESENT APPROXIMATELY 8000 FEET

HEIGHT OF BLOCK REPRESENTS APPROXIMATELY 400 FEET

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Schematic Block Diagram Showing Stratigraphic Setting at EMF Facilities		
JOB No.	DRAWING NO.	REV.
21372	FIGURE 3.1-4	



G'
TW-11I
519
E'
D' 502
516
515
C' 514
G
TW-12S
518
F'
508
509
109 110
330
320 319
327
SWP-5
311
312
324
SWP-4
SWP-6
317 318
328
A'
506
507 322
332
520
510
511 B'
500
501
123
144 145
136
309
310
313
316
315
112
133
134
121
143
308
E
323
140
159
141
106
307
306
F
128 139
124
118
117
150
104
103
153
149
142
333
A
C
D
130 137
102
101
B
Legend:
A A' Line of Section
101 Well and Boring Location
Former Pond Locations
N
0 500 1000 FEET
0 100 200 300 METERS
Note:
Hydrogeologic sections were constructed by projecting borings onto nearest plane. Point to point lines on this figure are illustrative only.
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Locations of Hydrogeologic Sections
Job Number
21372
Drawing No.
FIGURE 3.1-5
Rev.



NOTES:

1) Ground surface line is generalized
2) Vertical exaggeration = 5x
3) Cross-section is generalized.
See boring logs in Appendix for further details.

Legend:

Water level

Well screen

SAND
GRAVELLY SAND
SILTY SAND
CLAYEY SAND
SANDSTONE
GRAVEL
SAND AND GRAVEL
SILTY, SANDY GRAVEL
SILTY GRAVEL
CLAYEY GRAVEL

SILT
CLAYEY SILT
SANDY SILT
GRAVELLY SILT

CLAY
SILTY CLAY
SANDY CLAY
GRAVELLY CLAY

BASALT
RHYOLITE
TUFF

CALICHE
PEAT

ASPHALT
CONCRETE
FILL

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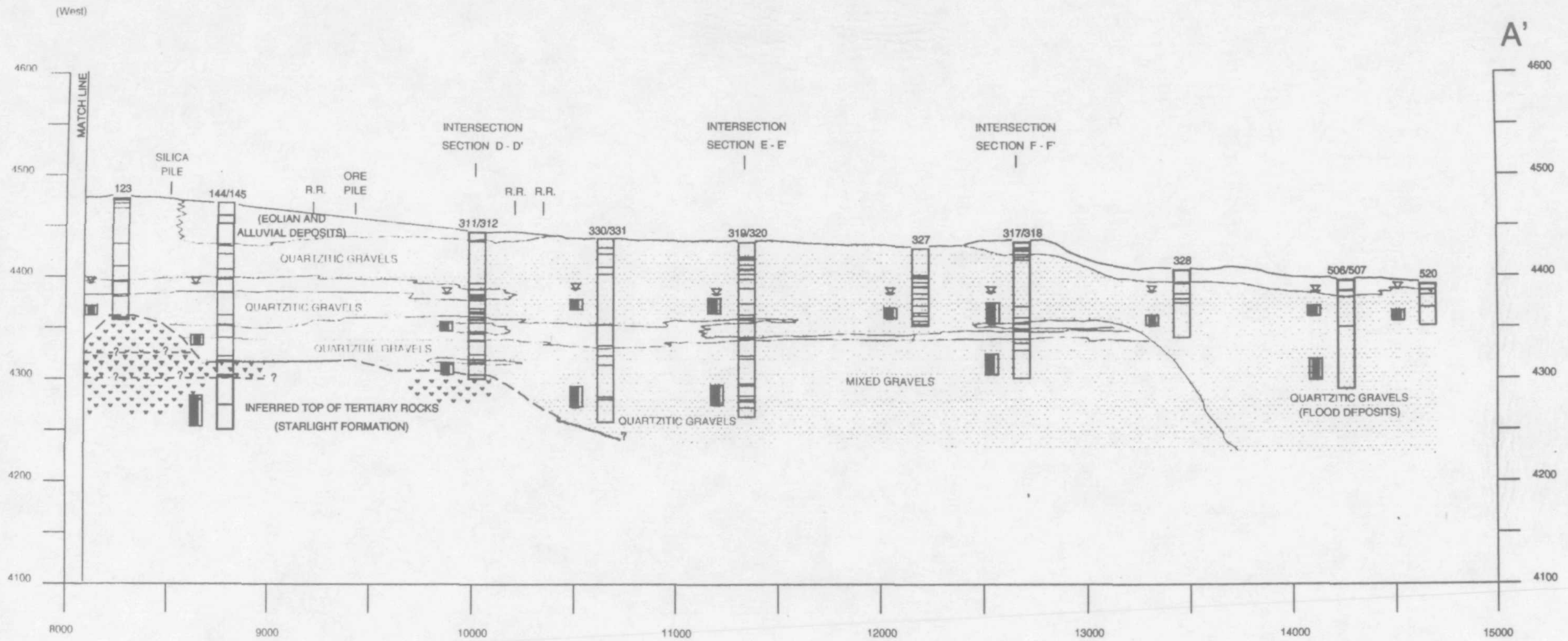
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeologic Cross-Section A-A' sheet 1 of 2

Job Number	Drawing No.	Rev.
21372	FIGURE 3.1-6A	



NOTES:

1) Ground surface line is generalized
2) Vertical exaggeration = 5x
3) Cross-section is generalized. See boring logs in Appendix for further details.

Legend:

Water Level

Well Screen

SAND GRAVELLY SAND SILTY SAND CLAYEY SAND SANDSTONE GRAVEL SAND AND GRAVEL SILTY, SANDY GRAVEL SILTY GRAVEL CLAYEY GRAVEL	SILT CLAYEY SILT SANDY SILT GRAVELLY SILT CLAY SILTY CLAY SANDY CLAY GRAVELLY CLAY	BASALT RHYOLITE TUFF CALICHE PEAT ASPHALT CONCRETE FILL

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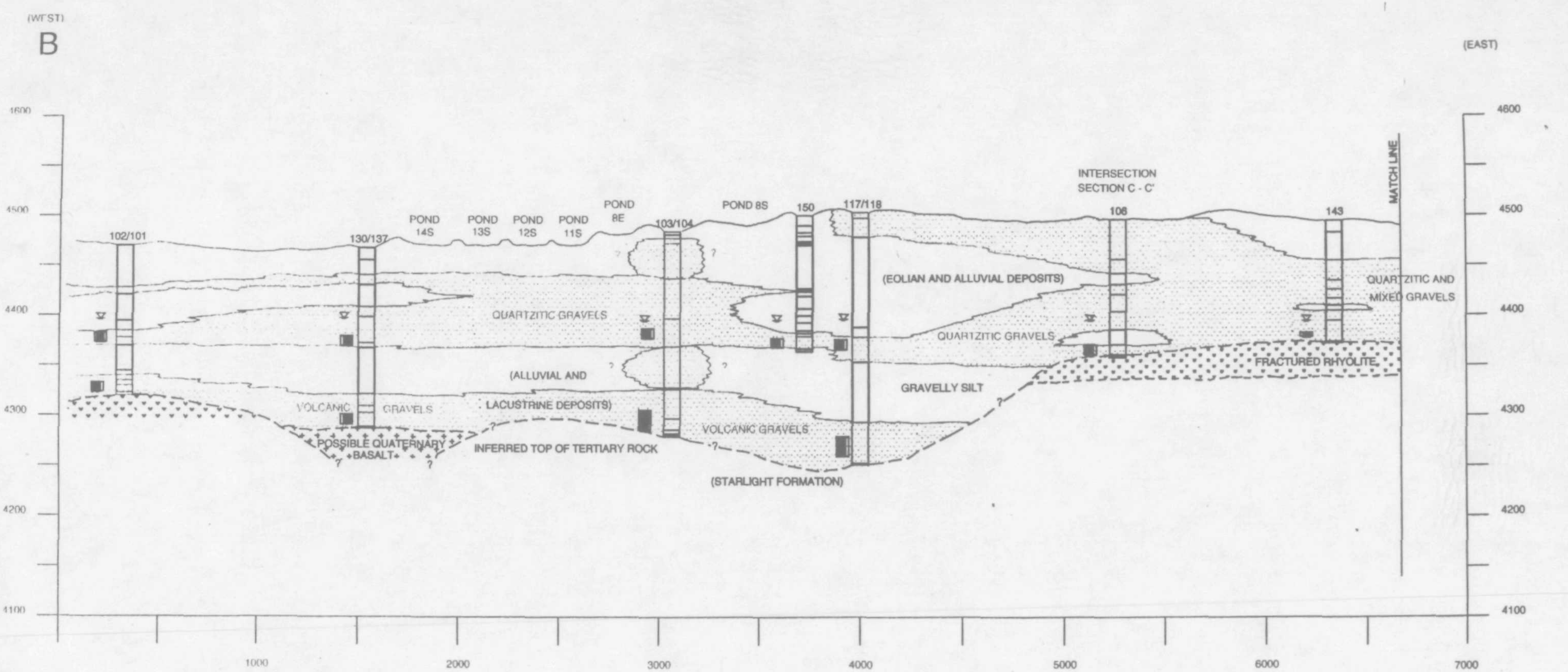
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeologic Cross-Section A-A'
sheet 2 of 2

Job Number	Drawing No.	Rev.
21372	FIGURE 3.1-6B	



Legend:

- Water level
- Well screen

SAND
GRAVELLY SAND
SILTY SAND
CLAYEY SAND
SANDSTONE
GRAVEL
SAND AND GRAVEL
SILTY, SANDY GRAVEL
SILTY GRAVEL
CLAYEY GRAVEL

SILT
CLAYEY SILT
SANDY SILT
GRAVELLY SILT

CLAY
SILTY CLAY
SANDY CLAY
GRAVELLY CLAY

BASALT
RHYOLITE
TUFF

CALICHE
PEAT

ASPHALT
CONCRETE
FILL

NOTES:

1) Ground surface line is generalized
2) Vertical exaggeration = 5x
3) Cross-section is generalized. See boring logs in Appendix for further details.

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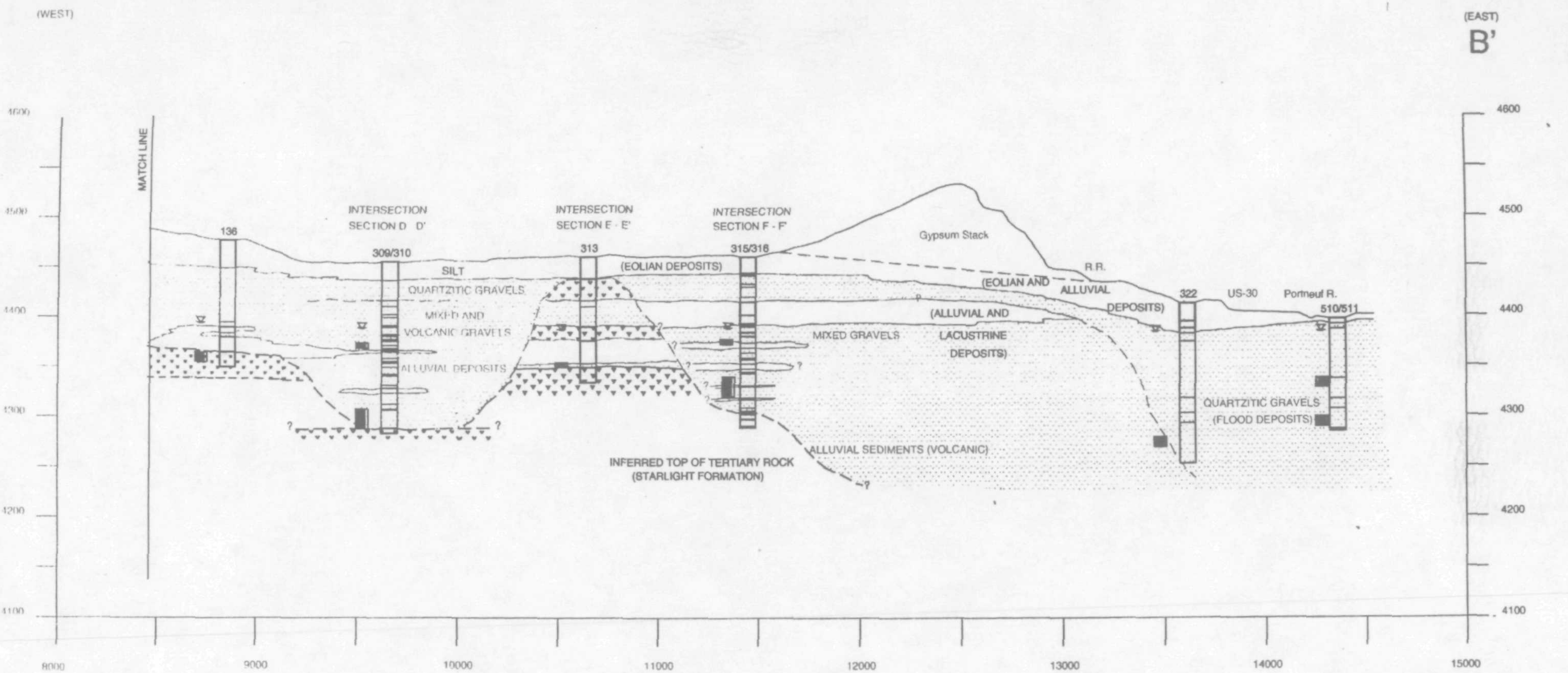
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeologic Cross-Section B-B'
sheet 1 of 2

Job Number	Drawing No.	Rev.
21372	FIGURE 3.1-7A	



Legend:

Water level
Well screen

SAND
GRAVELLY SAND
SILTY SAND
CLAYEY SAND
SANDSTONE
GRAVEL
SAND AND GRAVEL
SILTY, SANDY GRAVEL
SILTY GRAVEL
CLAYEY GRAVEL

SILT
CLAYEY SILT
SANDY SILT
GRAVELLY SILT

CLAY
SILTY CLAY
SANDY CLAY
GRAVELLY CLAY

BASALT
RHYOLITE
TUFF

CALICHE
PEAT

ASPHALT
CONCRETE
FILL

NOTES:
1) Ground surface line is generalized
2) Vertical exaggeration = 5x
3) Cross-section is generalized. See boring logs in Appendix for further details.

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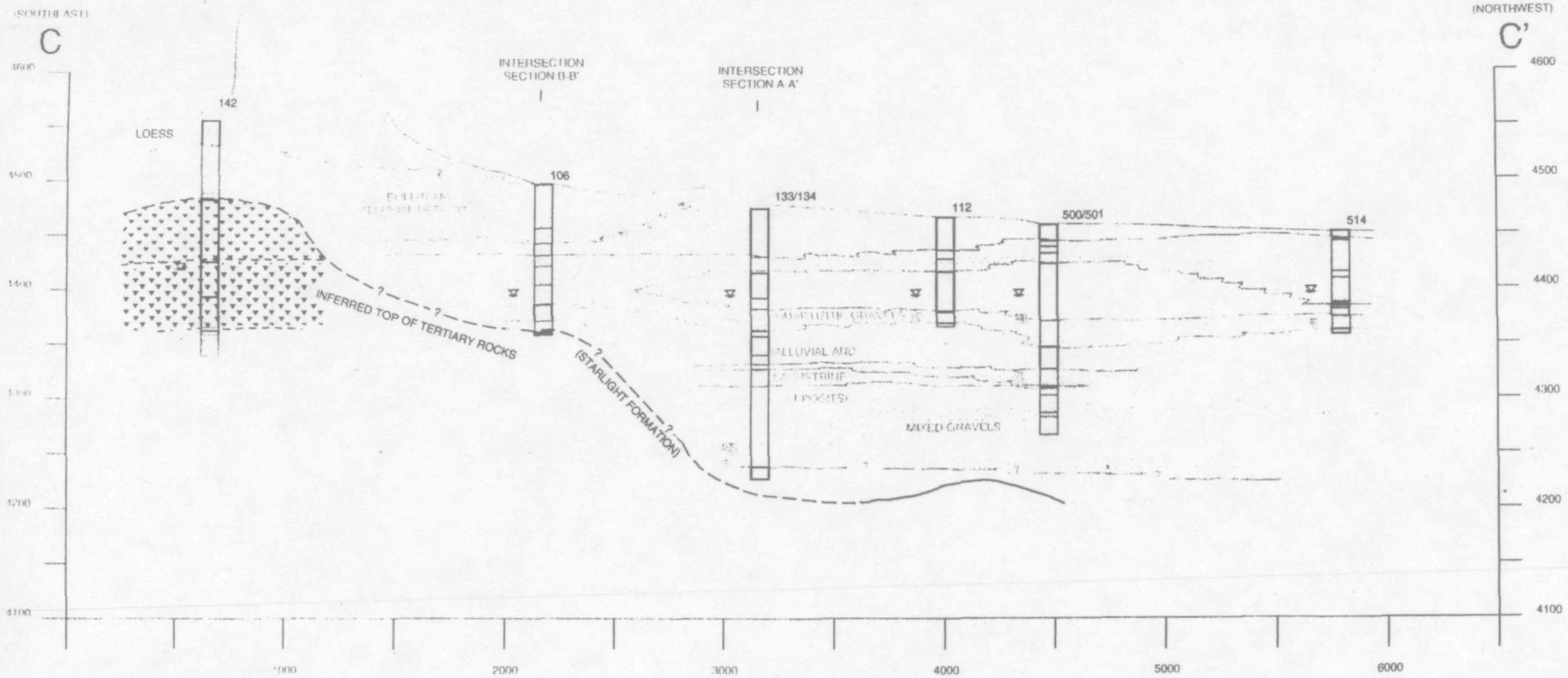
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeologic Cross-Section B-B' sheet 2 of 2

Job Number	Drawing No.	Rev.
21372	FIGURE 3.1-7b	



Notes:

1) Ground surface line is generalized.

2) Vertical exaggeration = 5x

3) Cross-section is generalized.
See boring logs in Appendix for further details.

Legend:

Water level

Well screen

SAND
GRAVELLY SAND
SILTY SAND
CLAYEY SAND
SANDSTONE
GRAVEL
SAND AND GRAVEL
SILTY, SANDY GRAVEL
SILTY GRAVEL
CLAYEY GRAVEL

SILT
CLAYEY SILT
SANDY SILT
GRAVELLY SILT

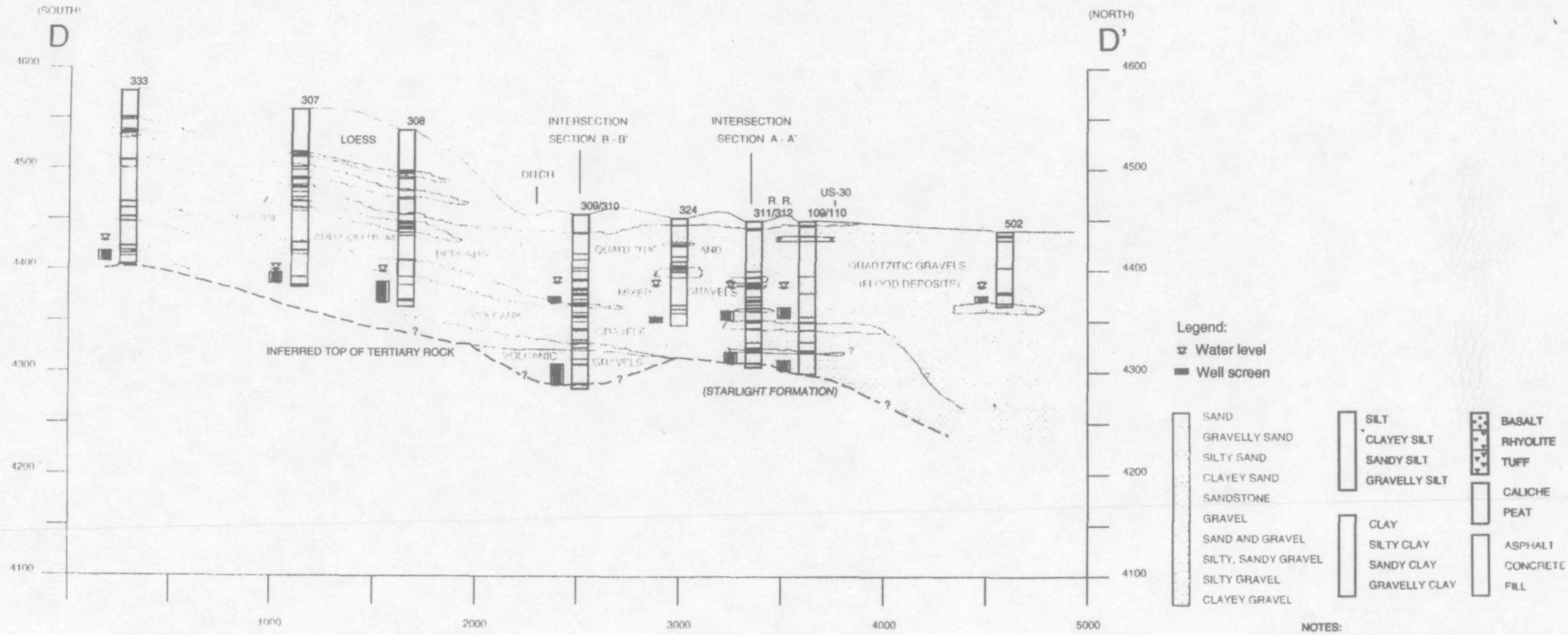
CLAY
SILTY CLAY
SANDY CLAY
GRAVELLY CLAY

BASALT
RHYOLITE
TUFF

CALICHE
PEAT

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO	
EASTERN MICHAUD FLATS POCATELLO, IDAHO	
Hydrogeologic Cross-Section C-C'	

Job Number	Drawing No.	Rev.
21372	FIGURE 3.1-8	



NOTES:

1) Ground surface line is generalized
2) Vertical exaggeration =5x
3) Cross-section is generalized.
See boring logs in Appendix for further details.

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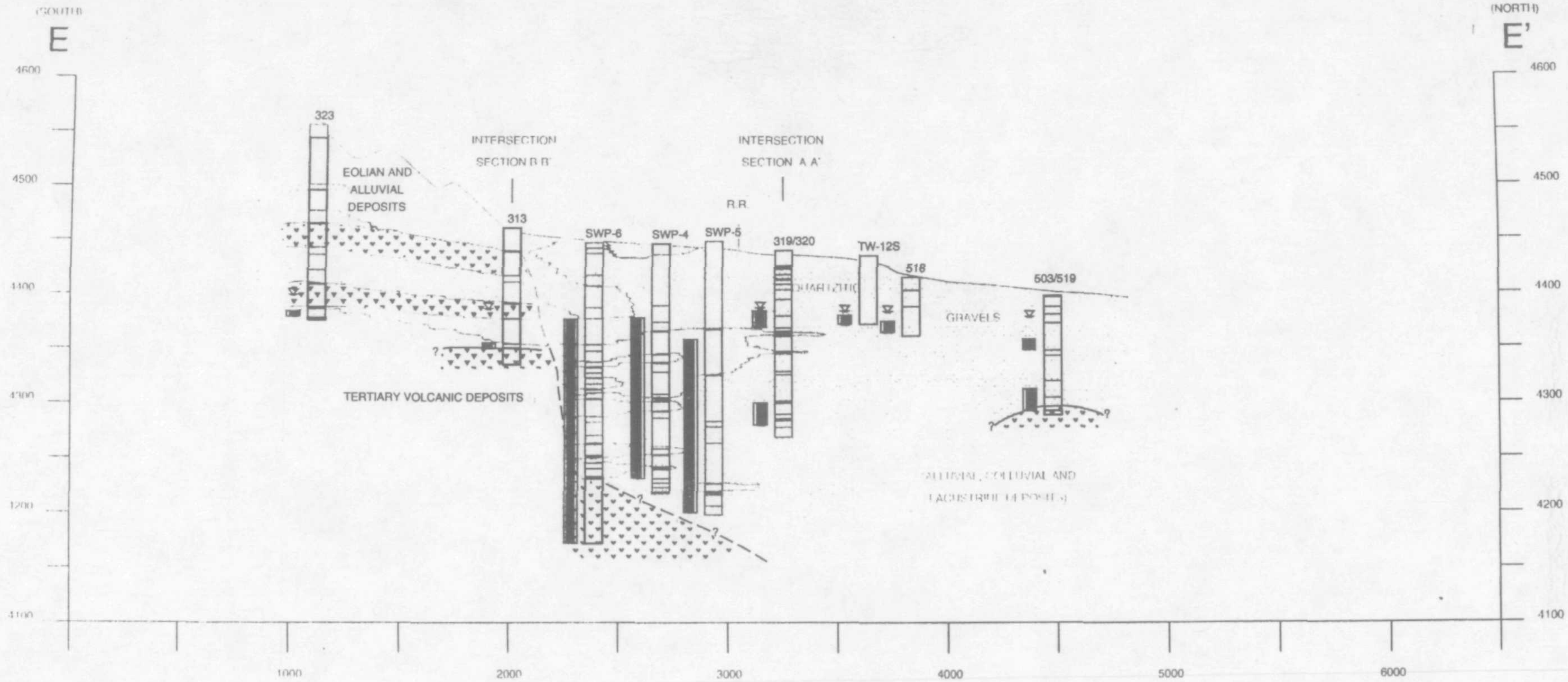
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeologic Cross-Section D-D'

Job Number	Drawing No.	Rev.
21372	FIGURE 3.1-9	



Legend:

- Water Level
- Well Screen

SAND GRAVELLY SAND SILTY SAND CLAYEY SAND SANDSTONE GRAVEL SAND AND GRAVEL SILTY, SANDY GRAVEL SILTY GRAVEL CLAYEY GRAVEL	SILT CLAYEY SILT SANDY SILT GRAVELLY SILT CLAY SILTY CLAY SANDY CLAY GRAVELLY CLAY	BASALT RHYOLITE TUFF CALICHE PEAT ASPHALT CONCRETE FILL

NOTES:

1) Ground surface line is generalized
2) Vertical exaggeration = 5x
3) Cross-section is generalized. See boring logs in Appendix for further details.

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EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeologic Cross-Section E-E'

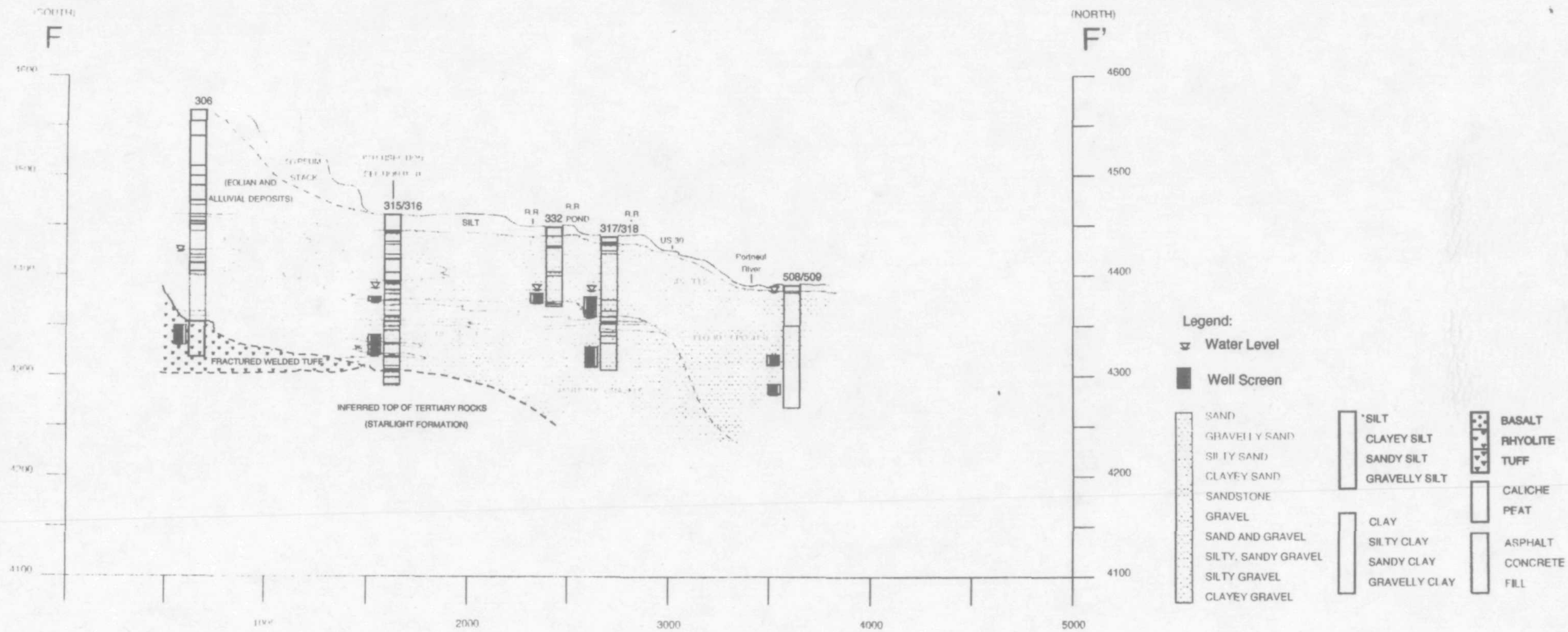
Job Number	Drawing No.	Rev.
21372	FIGURE 3.1-10	

NOTES:

1) Ground surface line is generalized

2) Vertical exaggeration = 5x

3) Cross-section is generalized. See boring logs in Appendix for further details.



BECHTEL ENVIRONMENTAL, INC.
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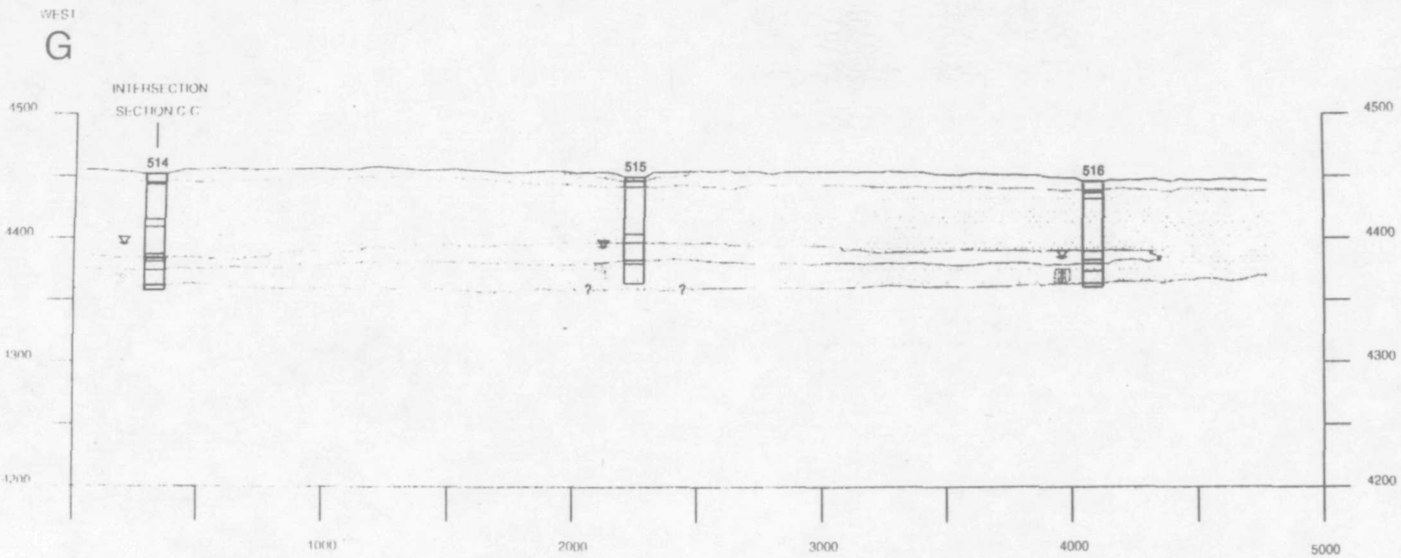
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeologic Cross-Section F-F'

Job Number	Drawing No.	Rev.
21372	FIGURE 3.1-11	

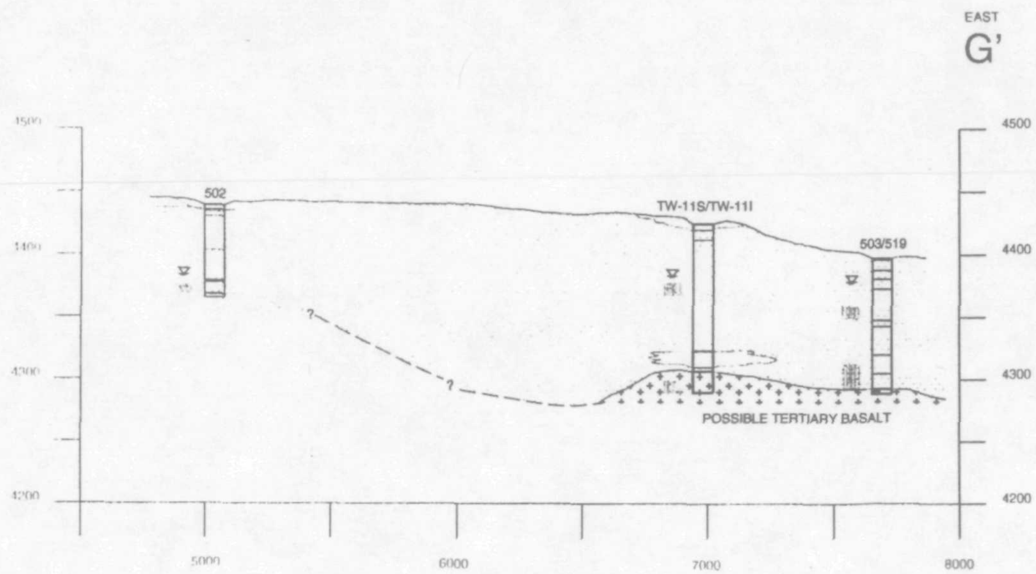


Notes:

1) Ground surface line is generalized.

2) Vertical exaggeration = 5x

3) Cross-section is generalized.
See boring logs in Appendix for further details.



Legend:

Water Level

Well Screen

SAND
GRAVELLY SAND
SILTY SAND
CLAYEY SAND
SANDSTONE
GRAVEL
SAND AND GRAVEL
SILTY, SANDY GRAVEL
SILTY GRAVEL
CLAYEY GRAVEL

SILT
CLAYEY SILT
SANDY SILT
GRAVELLY SILT

CLAY
SILTY CLAY
SANDY CLAY
GRAVELLY CLAY

BASALT
RHYOLITE
TUFF

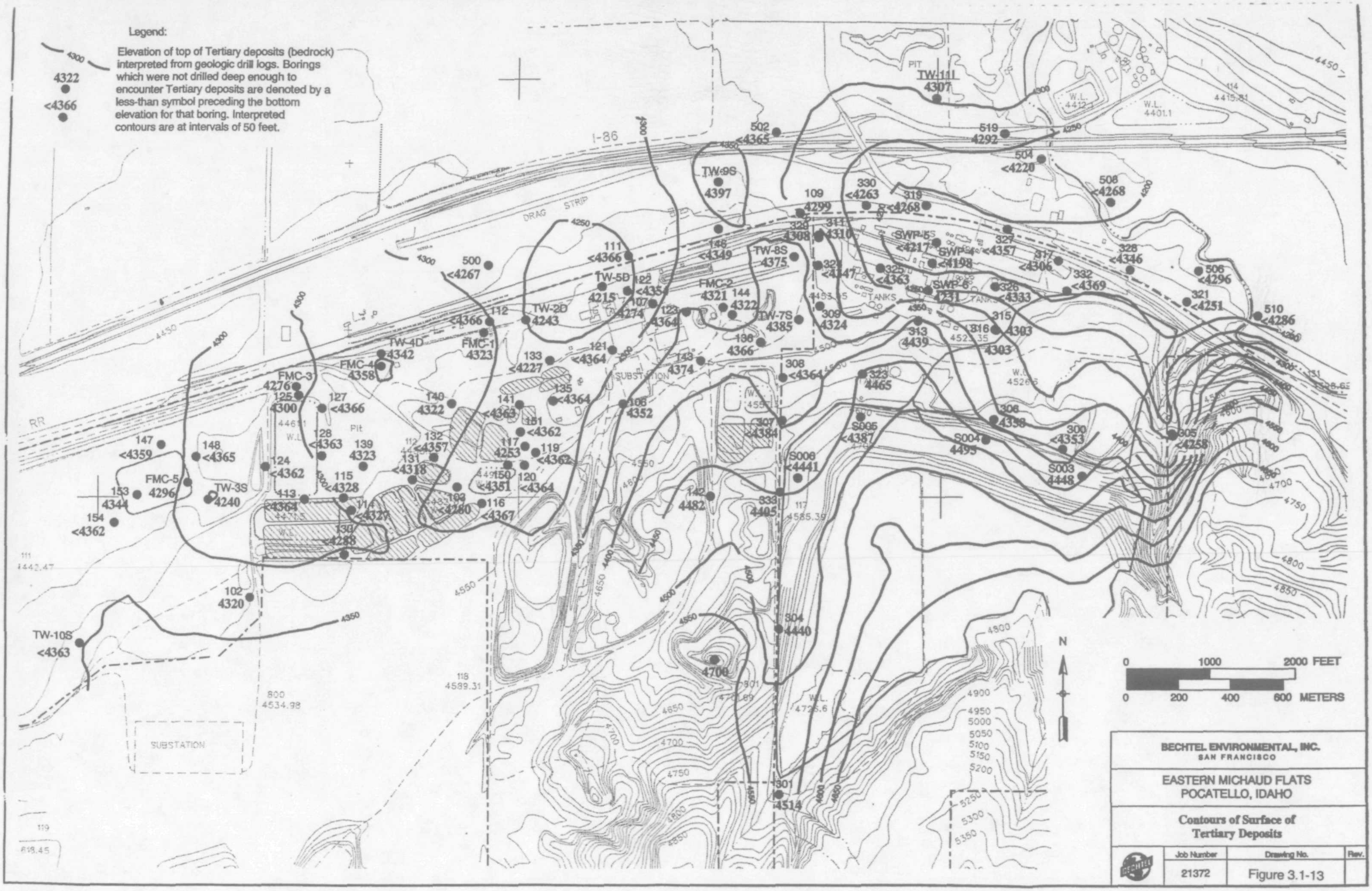
CALICHE
PEAT

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeologic Cross-Section G-G'

Job Number	Drawing No.	Rev.
21372	FIGURE 3.1-12	


Legend:
Elevation of top of Tertiary deposits (bedrock) interpreted from geologic drill logs. Borings which were not drilled deep enough to encounter Tertiary deposits are denoted by a less-than symbol preceding the bottom elevation for that boring. Interpreted contours are at intervals of 50 feet.
4300
4322
<4366
I-86
DRAG STRIP
RR
SUBSTATION
TANKS
PIT
N
0 1000 2000 FEET
0 200 400 600 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Contours of Surface of Tertiary Deposits
Job Number
Drawing No.
Rev.
21372
Figure 3.1-13

3.2 DRAINAGE AND SURFACE WATER HYDROLOGY

Section 3.2.1 presents the regional characteristics of surface waters in the EMF study area. This includes a description of river morphology and sediment deposition patterns. Section 3.2.2 discusses site-specific drainage patterns and potential runoff associated with storm events.

Due to the topography of the EMF facilities, surface water runoff does not leave the facilities during typical storm events. As discussed in Section 3.2.2, the runoff produced by the maximum observed storm would not exceed the holding capacity of local depressions within the facilities.

3.2.1 REGIONAL HYDROLOGY AND RIVER MORPHOLOGY

Major surface water features of the region include the Snake River, Portneuf River, and the American Falls Reservoir (Figure 3.2-1). The reservoir is an impoundment of the Snake and Portneuf rivers and Bannock Creek, among others; both rivers discharge into the reservoir at its east end. Figure 3.2-1 also summarizes data with respect to the drainage areas and the contribution of inflow of water and sediment from the rivers to the reservoir. The Snake River data are from the Snake River gauging station near Blackfoot (gauge 13069500); the Portneuf River is gauged at Pocatello (gauge 1307550), 17 miles upstream of the reservoir and at Tyhee Station, near Tyhee Road.

A more detailed discussion of the data on water flow and sediment transport of the Snake River, Portneuf River, and American Falls Reservoir is presented in Section 3.2.1.1. Also included is a discussion of river morphology and associated sediment deposition patterns.

Snake River

The Snake River has a moderately straight river channel, downcut into the basalts of the Snake River Plain. In places, the river is significantly entrenched into the basalts.

Upstream of the American Falls Reservoir, the Snake River drainage is 11,310 square miles (2.9 million hectares), including watersheds of the Blackfoot River, Henry's Fork, Teton River, and portions of western Wyoming (Figure 3.2-2). Sediments deposited in the American Falls Reservoir may originate from a large number of watersheds and reflect anthropogenic activities throughout this area.

A fraction of the sediments transported by the Snake River and subsequently deposited in the American Falls Reservoir is derived from the Phosphoria Formation, which crops out extensively throughout the upper Snake River drainage basin in western Wyoming and eastern Idaho (Swanson et al., 1953). Phosphoria Formation sediments will likely be found in the fine-grained suspended sediment load because the Phosphoria Formation is a shale, which weathers rapidly to clay and silt. This shale is the feedstock for the EMF facilities, and past releases from the facilities may be difficult to resolve from naturally occurring phosphoric shale in the reservoir sediments.

Portneuf River

The Portneuf River drainage area is approximately 1,250 square miles. In geomorphologic terms, the Portneuf River displays two distinct channel types: one is a high sinuosity pattern associated with bars and a low width/depth ratio; the other is a moderately straight pattern (low sinuosity) with a high width/depth ratio (Figure 3.2-3). Channel characteristics are associated with flow rates and riverbed gradient. The types of deposits sampled during the RI field investigation were predominantly fine-grained deposits collected from point bars, chute bars, and the local floodplain of the river (Figure 3.2-4). Results of this sampling are discussed in Section 4.5.

Upstream of the EMF facilities, the river flows in a relatively steep valley between the Pocatello and Bannock ranges (Figure 1.3-1). Near the EMF facilities, the river emerges onto the Michaud Flats along the base of the Bannock Range. The river runs across the flats incised in a shallow, flat-bottomed valley that widens from about 0.5 mile (0.8 km) at the Bannock Range to over 1.5 miles (2.4 km) near the reservoir. At the reservoir, the broad flat-bottomed area is called the Fort Hall Bottoms (Figure 3.2-5).

The river course increases in sinuosity from the Bannock Range area to the Fort Hall Bottoms. Where there is a distinct increase in gradient (typically 0.19 percent), the river becomes moderately straight. Where the gradient decreases (typically 0.11 percent), the river follows a high sinuosity pattern (Figure 3.2-4).

American Falls Reservoir

The American Falls Reservoir covers 88 square miles (22,800 hectares), and has a capacity of 1.7 million acre-feet (2,097 million cubic meters). The reservoir level fluctuates seasonally, with high levels occurring during peak runoff in spring. The maximum potential elevation of 4,354.5 feet above mean sea level is controlled by the height of the dam at American Falls. During high water levels, the reservoir floods much of the Fort Hall Bottoms, as evidenced by stressed trees along the banks (Fenwick, 1993a).

3.2.1.1 Sediment Load Analysis

An analysis of the average annual sediment load from the Snake and Portneuf rivers was performed to provide a basis for comparing the relative contribution of sediment to the American Falls Reservoir. Sediment-discharge curves were developed for three gauges on the Snake and Portneuf rivers from suspended sediment data collected by the USGS. Daily sediment loads for each station were estimated by applying the sediment-discharge curves to daily flow data also collected by the USGS and retrieved from the National Water Data Storage and Retrieval System (WATSTORE).

Daily flow measurements are recorded by the USGS for the Snake River at Blackfoot, Idaho, station and for the Portneuf River at Pocatello and at Tyhee Road (Figure 3.2-1). The Pocatello and Snake River stations have continuous flow records from 1950 through 1989; however, the Tyhee Road station only has records from May 1985 to September 1989 and after October 1990. The drainage area tributary to the Snake River gauge is 11,310 square miles, and the Portneuf

River tributary at the Pocatello gauge is 1,250 square miles. The drainage area tributary to the Portneuf River at the Tyhee gauge is not listed by the USGS.

Sediment samples have been taken sporadically at all three gauging stations by the USGS; the sediment data are presented in Table 3.2-1. Data from the Snake River for June of 1976 were affected by the Teton Dam failure on June 6, 1976, and were not used for this analysis.

By correlating the sediment data versus flow data, a sediment-discharge rating curve was estimated by a Least-Squares Regression analysis to find the best fit of the data to an equation of the form:

$$Q_s = a\,Q^N$$

where

Q_S = The daily sediment load, in tons (T) per day,

Q = The flow rate, in cubic feet per second (cfs),

a and N = Constants that define the equation.

The constants a and N were derived for each station, as well as the correlation coefficient. These values are presented in the following table. Figure 3.2-1 presents the measured and predicted sediment load versus stream flow for each station.

Station	Constants		Correlation Coefficient (R)
	a	N	
Snake River at Blackfoot	0.0000335	1.8727	0.74
Portneuf at Pocatello	0.001290	1.9409	0.91
Portneuf at Tyhee	0.0000916	2.015	0.81

The derived equations were used to estimate the daily sediment load using the measured daily average flow. For the Tyhee station, flow data are only available from May 1985 to September 1989, and after October 1990. Therefore, for the Tyhee station, only the sediment load for

1985-1990 was calculated. The flow records for the Blackfoot and Pocatello stations permit calculation of sediment loads for the period from 1950 through 1989. The daily sediment loads were used to compute monthly totals, which are presented in Table 3.2-2. The calculated sediment loads only represent suspended sediment. An additional component of sediment load is the bed load, which was not measured by the USGS and was not included in this analysis.

The Portneuf River at Tyhee gauge, located downstream from the Pocatello gauge, was found to have a lower sediment load for the years that the gauge records overlap. The 1986-1988 average load for the Portneuf River at Pocatello was 67,300 tons per year (T/year). For the same period, the average load of the Portneuf River at Tyhee was only 16,200 T/year. This is despite the fact that the 1986-1989 average flow at Pocatello was 340 cfs while at Tyhee the average flow was 570 cfs. As discussed in more detail in Section 3.3, the increase in flow between the two stations is due to recharge from underflow and springs along the Portneuf River. The sediment loads calculated in this analysis are estimates based on very limited data and should not be considered "exact" numbers for comparison of sediment transport rates at the three different stations. The analysis indicates that less sediment is transported via suspended load at the Tyhee station than at the Carson Street gage in Pocatello. The deposition of suspended sediments occurring between the two gaging stations is also described in the City of Pocatello's STP assessment report of the Portneuf River, and in various other articles that describe the eutrophic, slow-moving, nature of the lower Portneuf River. The City of Pocatello's STP report describes a change in river character as "...the lower Portneuf exhibits changes in physical habitat as the gradient lessens and the river enters the area known as Michaud Flats. Between Highway I-15 downstream to Siphon Road, the Portneuf's channel changes from a substratum dominated by cobble and gravel to reaches with slower current and a bottom that is primarily mud and silt."

The probable causes for the reduction of suspended sediment load between the Pocatello and Tyhee gauges are irrigation water diversion dams and sediment deposition resulting from a decrease in river gradient between the two gauging stations. The diversion dams probably have a marked impact on sediment accumulation along the lower reaches of the Portneuf River, causing relatively large amounts of the fine-grained sediments to be deposited. The decrease in gradient is evident by the meandering nature of the Portneuf River along the lower reach, and fine-grained sediment deposition is more pronounced along the lower reaches of the Portneuf River, especially in the Fort Hall Bottoms, where spring high water will also erode sediments along the reservoir banks.

Some of the difference in the calculated sediment load between Pocatello and Tyhee could be due to the limited data available. Only 10 to 15 data points were collected for each station under a limited range of flow conditions which may not be representative of long-term conditions. The derived sediment load rating curves were extrapolated to determine the load for flows both higher and lower than the sediment sampling data. Given the large natural variability in suspended sediment data, the derived load estimates should be used only for crude comparisons.

The average annual sediment load from 1950 to 1989 for the Portneuf River at Pocatello was 54,500 T/yr, and for the Snake River at Blackfoot, 183,200 T/yr. The average annual flow for the same period for the Portneuf River at Pocatello was 310 cfs and 5,160 cfs for the Snake River at Blackfoot, Idaho. Further downstream on the Portneuf River at Tyhee, the average annual sediment load was 14,510 T/yr and the average flow was 516 cfs for the period from 1985 to 1990. Since the years of record for the Snake River and the Portneuf River at Tyhee gauges are not the same, their averages are not strictly comparable. A comparison of flows and sediment loads for a 3-year period for which records were available for both the Blackfoot and Tyhee gauging stations was therefore made to evaluate the representativeness of this analysis.

For the three years 1986 to 1988, the average annual load for the Snake River gauge was 178,500 T/yr, which is 97 percent of the 1950 to 1989 average of 183,200 T/yr. This indicates that the period from 1986 to 1988 is fairly representative of the long-term average with regard to sediment transport. The 1986-1988 average sediment load for the Portneuf River gauge at Tyhee was 16,250 T/yr. The 1986-1988 sediment load to American Falls Reservoir would therefore be

194,750 T/yr, with 8 percent supplied by the Portneuf River and 92 percent supplied by the Snake River. This corresponds closely to the proportion of average annual inflow to the reservoir for the same period, which is 9 percent (516 cfs) from the Portneuf River and 91 percent (5,160 cfs) from the Snake River. Thus, it appears that the long-term average contribution of the Portneuf to the sediment load in the American Falls Reservoir is less than 10 percent of the total.

3.2.2 EMF FACILITIES HYDROLOGY AND DRAINAGE

Surface runoff within both the Simplot and FMC facilities is infrequent and is contained within the facilities. In this section, the term runoff is used to refer to rainwater that does not infiltrate at the point of contact with the ground, but rather is transported by overland flow to another location at the facilities. As discussed in Section 3.5, historic rainfall totals have not been particularly high. Consequently, when storm runoff does occur it does not actually run off the facilities but is contained in the storm drainage facilities, onsite ponds and depressions, for eventual use in plant operations, evaporation, or infiltration.

The site investigation found no channels by which stormwater would normally discharge from the FMC or the Simplot facilities, other than the NPDES-permitted IWW ditch outfall from the FMC property to the Portneuf River. The EMF facilities are separated from the Portneuf River by the Union Pacific Railroad and Highway 30. The bed of the railroad is raised above the terrain of the industrial areas and forms a barrier separating the plants from the river.

To evaluate the hydrologic response from more severe storm conditions, the maximum 24-hour storm of record (1.82 inches) was analyzed. Runoff from this storm would be completely contained on the site by the current drainage system. The hydrologic response to a 24-hour, 2-year storm (1.15 inches) was also analyzed to assess the ability of the FMC and Simplot drainage systems to contain stormwater under storm conditions. This storm was selected based on guidance from the Superfund Exposure Assessment Manual (EPA, 1988). Section 2.4 of the manual provides a method for quantitative analysis of surface water contamination. The recommended procedure is based on a calculation of the potential amount of contaminated soil transported by surface runoff releases from a site during an average storm. This analysis indicates that no surface water would be released during a 24-hour, 2-year storm at the EMF facilities. Thus, no contaminants would be released from unpermitted stormwater runoff.

For this analysis, the EMF study area was divided into seven major drainage areas based on the existing topography and drainage features. Several of these areas were further subdivided for the purpose of runoff calculation. Two of the areas are on the Simplot property, and five are on the FMC property (Figure 3.2-6). Each of these drainage areas is discussed in detail in the following subsections. The HEC-1 hydrologic simulation model was used to perform all runoff calculations.

3.2.2.1 Method of Analysis

Each drainage area described in this section was analyzed for runoff volume using the hydrologic simulation model HEC-1, developed by the U.S. Army Corps of Engineers (1990). The SCS curve number method was used to compute the rainfall excess for each watershed. The SCS curve number reflects the nonlinear relationship between rainfall excess and total storm depth; large storms have significantly larger runoff proportional to the rainfall than small storms. A detailed description of the SCS curve number method and how curve numbers were estimated is included in Appendix E.

The curve numbers used for the analysis are listed in Table 3.2-3. The curve number is related to the soil and cover condition of the watershed and was determined on the basis of observations conducted during the site reconnaissance in December 1992 and from the study of soil survey data obtained from the SCS.

The catchment areas were estimated by use of a planimeter and the site topographic maps prepared by Walker Associates (1992). Likewise, the capacities of ponding areas at FMC and the top of the Simplot gypsum stacks were estimated from the Walker maps. The estimated capacity of the other ponds at Simplot was provided by Simplot personnel.

Hydrographs of runoff were computed for each watershed using the SCS unit hydrograph method. This method requires a single parameter, the lag time, to define the distribution of runoff from a watershed in response to a unit of rainfall excess. The lag time was estimated as 0.6 times the travel time of the longest flow path in the watershed. The travel time was estimated from the length, slope, and roughness characteristics of watershed.

The seven separate drainage areas analyzed are described below and shown in Figure 3.2-6. The drainage area, curve number, and lag time for each area are presented in Table 3.2-3. Table 3.2-4 presents the results of the hydrologic analysis for the 2-year, 24-hour storm and maximum observed 24-hour storm scenarios.

3.2.2.2 Simplot

The natural drainage features of the Simplot property originally consisted of five small ephemeral stream gullies that combined and entered the Portneuf River near the I-86 bridge. The combined drainage area for the five gullies is 825 acres (335 hectares). The lower third of the gullies has been covered by Simplot's gypsum stacks. Runoff from the upper watershed of the gullies now flows to the top of the gypsum stacks.

The Simplot main plant covers the area from the gypsum stacks north to the UPRR. The bed of the railroad is higher than the adjacent plant area and forms a barrier that isolates surface water on the plant. Surface water potentially leaves the plant area via three routes: the main plant stormwater and noncontact water drainage line; the east drain; and a pipe which drains a small undeveloped containment area along the northeast boundary of the Simplot plant.

The main plant stormwater and noncontact water drainage line and the east drain flow into the water treatment pond system, just north of Highway 30. Water from the treatment system is then pumped across the Portneuf River to the surge pond for subsequent delivery to irrigators.

The small undeveloped containment area has a drainpipe (installed by UPRR) to the Portneuf River that serves as an overflow outlet in the unlikely event that the swale behind the railroad grade fills with runoff. Since this area is undeveloped and largely outside the Simplot property, it was not considered further in this analysis.

The following subsections describe the separate drainage areas on the Simplot property. The drainage area location map, Figure 3.2-6, shows their locations. Each area was modeled for a 24-hour, 2-year storm of 1.15 inches (3 cm) of rainfall and for the maximum 24-hour storm of record, 1.82 inches (4.6 cm). The results are included with the area descriptions.

Gypsum Stack Area (SIM1)

The area on top and above the gypsum stack forms an isolated drainage area indicated as SIM1 on the drainage area map (Figure 3.2-6). It includes the upper reaches of four small intermittent streams that drain onto the gypsum stack from the south. The total drainage area is about 825 acres (335 hectares).

Gypsum, a by-product of Simplot's manufacturing process, is pumped to the top of the gypsum stack as a gypsum water slurry. As the gypsum settles out of the slurry, the water evaporates or infiltrates through the gypsum stack. To prevent excess accumulation of water on top of the stack, four 18-inch (46 cm) diameter drain lines with 8-inch (20 cm) diameter standpipes collect seepage and decant ponded water from the stack. As the stack rises over time due to accumulation of gypsum, the drain lines are extended to the south, and additional standpipes are emplaced. Gypsum dikes, a minimum of 3 feet (0.9 m) high, surround the top of the gypsum stack and contain the slurry water and stormwater that accumulate on top of the gypsum stack.

Under normal operation, all water, including stormwater, that collects on top of the gypsum stacks either infiltrates, evaporates, hydrates with calcium and silica present in the waste facilities, or is collected by the drain lines for reuse in the plant or as slurry water. The drainlines discharge into a 10,000-gallon (38 cubic meter) decant tank on the lower, northernmost gypsum stack. A 24-inch (61 cm) high-density polyethylene (HDPE) pipe conveys water from the decant tank to the process sump.

The native soils in this drainage are largely silt loams of hydrologic soil group B. Plant personnel have never observed rainwater running off of the gypsum stack, indicating that it also has a low curve number. A curve number was estimated as 75.

To test the ability of the gypsum stack to contain storm runoff, an estimate of the storm runoff was calculated using the HEC-1 model. From the maximum 24-hour storm of record, the total runoff was estimated to be 6.70 million gallons (MG) (25,360 cubic meters). The total runoff ponding on the gypsum stacks from a 24-hour, 2-year storm was estimated to be 1.30 MG (4,920 cubic meters). The ponded water would accumulate in three separate areas: the lower northernmost gypsum stack, and the eastern and western halves of the upper gypsum stack, which are separated by a dike. The combined storage capacity of the gypsum stacks is 125 MG (473,100 cubic meters), well in excess of what is needed to contain the runoff.

The analysis indicates that the drainage areas on top of the gypsum stacks can contain the runoff from both a 24-hour, 2-year storm and the historic maximum 24-hour rainstorm. The analysis was based on existing topography as presented in the Walker maps of August 1992. In the future, the configuration of the gypsum stack and dike could change as additional gypsum accumulates.

Main Plant Area (SIM2)

The drainage area around the Simplot main plant, designated SIM2 in Figure 3.2-6, extends from approximately the property boundary bordering FMC on the west, to the UPRR on the north, to the dike on top of the gypsum stacks on the south, and the lower gypsum stack on the east. This area was further subdivided into five sub drainages, as listed in Table 3.2-3, for analysis. The combined drainage area is 185 acres.

The southern portion of this area (subdrainage PTB) encompasses most of the north flank of the gypsum stacks and a small portion of the FMC facility adjacent to the IWW pond. The curve number for this area was estimated to be 73. Runoff is directed to sewer inlets and conveyed by branch sewer lines to the 32-inch (81-cm) HDPE main plant drainage line running from south to north through the center of the main plant area. A 30-inch (76-cm) culvert conveys the water under the railroad and highway to a pipe leading to the holding pond within the water treatment pond system. Drainage from around the main plant facilities (subdrainage plant) is also collected by the plant drainage line. The curve number for the plant area was estimated to be 93.

Most of the eastern portion of the area (subdrainages ROAD and OGS) drains into an area contained by a new stormwater containment berm which provides a storage capacity of 1.5 MG (5,700 cubic meters). This area includes portions of the slopes of the gypsum stacks and was estimated to have a curve number of 75. An area (subdrainage PSA) of approximately 10 acres (4 hectares) is not contained by this berm but drains to the process sump. Its curve number was estimated to be 80. The sump combines decant water from the gypsum stack, reclaimed wastewater, and storm runoff. Up to 35,000 gpm (2.20 cubic meters per second) are regularly pumped from the sump back into the phosphoric acid production process. Additional capacity exists to pump up to 6,000 gpm (0.4 cubic meter per second) of slurry or water from the sump to the ponds on top of the upper gypsum stack. Overflow from the sump would flow to a newly constructed lined pond which has replaced (and which is adjacent to) the former east overflow pond, via a 24-inch (61-cm) HDPE pipe.

The pond that has replaced the former east overflow pond, besides receiving overflow from the sump, collects some local surface runoff from the area between the lower gypsum stack and the Union Pacific Railroad. The pond has a capacity of approximately 1 MG (3,800 cubic meters).

Overflow from the pond is conveyed by the east drain, a 24-inch HDPE pipe, under the railroad to the holding pond within the water treatment pond system.

Water from the 1.25 MG (4,700 cubic meters) capacity holding pond is released to the 1.25 MG (1,500 cubic meters) equalization pond after treatment, then pumped to the 13 MG (49,000 cubic meters) surge pond north of the Portneuf River. The maximum pumping capacity is 1,800 gpm (6.8 cubic meters per second).

During a storm equivalent to the maximum historic 24-hour storm, the peak flow of runoff from the plant area tributary to the main plant drainage culvert was estimated to be 31,000 gpm (1.9 cubic meters per second), including 350 gpm (0.02 cubic meter per second) of normal process water. This is well below the culvert's capacity of 60,000 gpm (3.78 cubic meters per second). There would be no flow through the east drain. The total volume of storm runoff conveyed to the holding pond would be 2.51 MG (9,500 cubic meters), of which 1.62 MG (6,100 cubic meters) would be pumped to the surge pond during the storm. Therefore, no stormwater would be released to the river.

Portneuf River Floodplain

An attempt was made to investigate the location of the plant with respect to the 100-year floodplain of the Portneuf River as designated by the National Flood Insurance Program. This program, part of the Federal Insurance Administration, publishes maps of select regions of the United States designating 100-year and 500-year flood boundaries. Flood insurance rate maps for both Bannock County and the City of Pocatello, Idaho, were reviewed; no studies were conducted for Power County. Neither of the studies reviewed encompassed the Portneuf River in the EMF study area.

3.2.2.3 FMC

The original drainage at FMC has been significantly modified by the placement of slag piles and holding ponds at the facility. In general, the FMC property is now highly compartmented with respect to the handling of stormwater. There are parts of five separate drainage areas on the property, separated by natural ridges, slag piles, and dikes.

In addition to the five main drainage areas, there are several process water storage ponds on the site with a minimum of 2 feet (0.6 m) of freeboard. The ponds are contained by dikes rising well above the surrounding terrain and are not subject to runon from other areas. The freeboard of 2 feet (0.6 m) is more than adequate to contain rainfall in these ponds for a storm of less than 2 inches (5 cm).

The following subsections describe the separate drainage areas on the FMC property (Figure 3.2-6). Each area was modeled for a 24-hour, 2-year storm of 1.15 inches (3 cm) and for the historical maximum 24-hour storm of 1.82 inches (4.6 cm). The results are included with the area description and in Table 3.2-4.

Drainage Area FMC1

This area includes the IWW basin, and is bounded by the east slope of the slag piles, the west slope of the Simplot gypsum stack, and extends south to a natural ridge approximately 1 mile (1.6 km) south of the FMC plant buildings. The total drainage area is about 114 acres (46 hectares).

The capacity of the 12-inch (30 cm) IWW discharge pipe was estimated as 2,150 gpm (0.14 cubic meter per second), slightly more than the maximum historical monthly average flow of 2,130 gpm (0.13 cubic meter per second) recorded by FMC in March 1993.

The native soils in this area is silt loam, classified as hydrologic soil group B by the SCS. These are overlain by coarse slag and ore stockpiles in some areas. A curve number of 71 was estimated.

There are two places where water ponds onsite in this area, in a depression adjacent to the plant haul road and adjacent to the main plant ore stockpile. The ponding storage capacity of these are, respectively, 1.1 MG (4,200 cubic meters) and 0.95 MG (3,600 cubic meters). The maximum historic storm would produce only 0.6 MG (2,300 cubic meters) of runoff; therefore all runoff would be contained onsite. The 2-year storm would produce only 0.1 MG (380 cubic meters) of runoff.

Drainage Area FMC2

This area consists of the slag pit and the slag piles immediately to the south. The total drainage area is 94 acres (38 hectares). The soils are silt loam covered by coarse slag; a curve number of 71 was estimated. Runoff from this area would flow down to the slag pit just south of FMC's furnace building. A total of 0.51 MG (1,930 cubic meters) would result from the maximum historic storm, and a total of 0.08 MG (340 cubic meters) of runoff would result from a 24-hour, 2-year storm. The slag pit has a storage capacity of 5.7 MG (22,000 cubic meters), well in excess of the total runoff. Therefore, no releases from this area could occur.

Drainage Area FMC3

This area consists of the main plant area, excluding the western portion of the employee parking lot, which is served by storm sewers.

The total drainage area of 28.5 acres (11.5 hectares) is substantially covered by parking lots and buildings. A curve number of 93 was estimated based on the SCS recommendation for industrial facilities.

The railroad swale, which receives the runoff from the area around the plant buildings, is a long, narrow depression about 30 feet (9 m) wide and 1,000 feet (300 m) long. While it is about 8 feet (2.5 m) deep at its western end, near the plant headquarters, the ground level above the swale slopes downward to the east so that it is about only 2 feet (0.6 m) deep at its east end. The storage volume is about 0.6 MG (2,300 cubic meters).

The runoff volume from the maximum historic 24-hour storm was estimated to be 0.89 MG (3,400 cubic meters) and from a 24-hour, 2-year storm, runoff was estimated to be 0.44 MG (1,700 cubic meters). Overflow from the railroad swale would flow onto the Simplot facility and be captured by the Simplot plant sewer. This overflow was included in the calculation of runoff discussed above for area SIM1. Such an overflow has never been observed to actually occur according to both Simplot and FMC personnel.

Drainage Area FMC4

This area consists of a small valley south of the slag pile that surrounds FMC's landfill. The valley extends 1.2 miles (1.9 km) south to a ridge in the Bannock Hills. The watershed is about 485 acres (195 hectares) in area and, south of the landfill, it remains undeveloped. The area is predominantly covered by silt loam soils, with some rocky slopes at the higher elevations. A curve number of 80 was estimated.

The southwestern two-thirds of the basin are outside of the FMC property boundary. The slag pile completely fills the bottom of the north end of the valley, effectively blocking the flow of surface water. At the lowest point in the valley, the top of the slag pile is at elevation 4,588 feet (1,398 m) above MSL, whereas the valley floor is at 4,550 feet (1,387 m) above MSL. Thus, a 38-foot-deep (12-m-deep) depression is formed behind the slag pile. The storage capacity of this depression was estimated to be 54.7 MG (207,000 cubic meters).

The total runoff volume from the maximum historic 24-hour storm was estimated to be 6.0 MG (2,300 cubic meters) and from a 24-hour, 2-year storm, 1.7 MG (6,400 cubic meters). Therefore, no releases would result.

Drainage Area FMC5

This area consists of all FMC property west of the main plant area and slag piles. It includes the Bannock Paving facility, the western side of the slag piles, the western portion of the employee parking lot, and the undeveloped land west of the main FMC plant bounded roughly by Michaud Creek on the west, Taghee ditch on the north, and the south entrance road. The total drainage area within the FMC property is about 1,200 acres (480 hectares).

Site topography indicates that storm runoff in this area drains to the west to the undeveloped land just west of FMC's Ponds 9E and 15S. A depression is formed bounded by the foot of the Bannock Hills on the south, the elevated Taghee Canal and UPRR bed on the north. The ground rises gradually to the east and west. The total area of the depression is about 248 acres (100 hectares). At its lowest point, it is 9 feet (2.7 m) below the embankment of the UPRR and the Taghee Canal. The total volume of the depression is about 463 MG (1,750,000 cubic meters).

For the purpose of hydrologic modeling, drainage area FMC5 was divided into three subdrainages: Michaud, Bannock, and Local, as listed in Table 3.2-3. The Bannock subdrainage encompasses the Bannock Paving area and some surrounding areas, including about one-half of the employee parking lot. The curve number for the Bannock area was estimated to be 90. The Local area represents the remaining land within the FMC facilities, including the large, predominantly undeveloped field west of the operating area. The curve number was estimated to be 71. The Michaud area represents all of the Michaud Creek drainage, which is discussed below.

The runoff from the Bannock and Local areas was estimated using the HEC-1 model. Runoff from the maximum historic 24-hour storm was estimated to be 8.7 MG (33,000 cubic meters), well below the capacity of the depression. The ponded area is indicated in Figure 3.2-6. For the 24-hour, 2-year storm, the runoff volume was estimated to be 1.96 MG (7,400 cubic meters).

Just west of the FMC property boundary is Michaud Creek, an ephemeral stream that, when flowing, is captured by the Taghee Canal. Between the mouth of the valley where Michaud Creek flows north, out of the foothills, to the Taghee Canal, the creek crosses an alluvial fan formed from deposited sediment. The alluvial fan and stream channel are at a higher elevation than the FMC facility, and, therefore, runoff from the plant is blocked from reaching the stream. However, floodwaters from Michaud Creek could overflow the banks and cause flooding at FMC, leading to stormwater releases.

To investigate this scenario, Michaud Creek was included in the model of the western portion of the FMC facility. The stream valley is 7,488 acres (3,030 hectares) in area. It is entirely undeveloped rangeland with silt loam soils which belong to hydrologic group B. A curve number of 71 was estimated.

Flooding of a stream on an alluvial fan is highly unpredictable, and could flow in any direction from the valley mouth. The most conservative assumption is that after exceeding the capacity of Taghee Canal, the remainder of Michaud Creek would flow toward FMC.

For the maximum historical 24-hour storm, the runoff from Michaud Creek was estimated to be 40.7 MG (154,000 cubic meters). Combined with the flow from FMC, the total runoff would be 46.6 MG (187,000 cubic meters), well below the storage capacity of the depression. For the 2-year, 24-hour storm, a total of 4.56 MG (17,200 cubic meters) of runoff would result from Michaud Creek. Combined with the flow from FMC, the peak storage in the west field depression would be 6.52 MG (24,700 cubic meters).

Surface and Subsurface Characterizations
Tables for Section 3.2

TABLE 3.2-1
SUMMARY OF SEDIMENT TRANSPORT DATA

PORTNEUF RIVER, POCATELLO IDAHO				
Date	Time	Discharge (cfs)	Suspended Sediment (mg/l)	Sediment Load (tons/day)
07-Jun-74	0925	455	159	195
07-Jun-74	1050	455	159	195
25-Sep-74	1040	121	53	17
25-Jun-75	1140	713	210	404
23-Sep-77	1020(a)	118	97	31
08-Nov-77	0945	210	152	86
12-May-80	1150	915	589	1,453
20-May-81	1245	247	85	57
09-Jul-81	1315	51	21	3
15-Nov-90	1000	172	16	7
15-Mar-91	1500	265	134	96
16-May-91	1415	471	199	253
09-Jul-91	1415	62	58	10
18-Sep-91	1115	85	16	4
18-Nov-92	(a,b)	276	15	11
SNAKE RIVER, BLACKFOOT RIVER STATION				
Date	Time	Discharge (cfs)	Suspended Sediment (mg/l)	Sediment Load (tons/day)
07-Jun-76	0925(c)	52,200	1180	166,063
08-Jun-76	1050(c)	43,900	612	72,433
14-Jun-76	1040(c)	11,600	137	4,284
16-Jun-76	1140(c)	9,350	155	3,907
17-Jun-76	1020(a,c)	8,980	190	4,600
17-Jul-89	0945	2,970	23	184
19-Sep-89	1150	2,730	14	103
21-Sep-89	1245	2,400	5	32
16-Mar-90	1315	2,010	12	65
08-May-90	1000	1,230	15	50
12-Sep-90	1500	2,980	13	104
19-Nov-91	1415	3,000	8	65
19-Mar-92	1415	1,650	14	62
13-May-92	1115	2,960	20	160
30-Jul-92	1330	1,300	3	11
22-Sep-92	1530	1,560	4	17

TABLE 3.2-1 *(continued)*
SUMMARY OF SEDIMENT TRANSPORT DATA

PORTNEUF RIVER, TYHEE STATION				
Date	Time	Discharge (cfs)	Suspended Sediment (mg/l)	Sediment Load (tons/day)
17-Jul-89	0945	105	7	2
		110	11	3
19-Sep-89	1150	182	2	1
21-Sep-89	1245	239	3	2
16-Mar-90	1315	250	6	4
08-May-90	1000	259	10	7
12-Sep-90	1500	268	10	7
19-Nov-91	1415	354	8	8
19-Mar-92	1415	448	10	12
13-May-92	1115	470	40	51
30-Jul-92	1330	480	19	25
22-Sep-92	1530	508	61	84

Note: (a) Flow estimated from daily average.
(b) Time not available.
(c) Flow and sediment impacted by Teton Dam failure.

Table 3.2-2
Computed Sediment Discharge (tons per month)
Portneuf River, Pocatello Idaho

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1950	3,020	4,850	8,640	12,960	16,160	7,370	1,160	660	1,600	2,670	3,450	3,100	65,600
1951	2,460	4,530	4,760	7,390	3,860	300	120	490	450	1,580	2,830	2,680	31,500
1952	2,420	1,970	3,020	13,340	18,040	1,730	370	460	540	680	2,420	3,030	48,000
1953	4,400	3,150	4,010	4,760	2,440	4,000	130	200	210	770	1,980	2,460	28,500
1954	2,220	2,580	3,870	4,010	590	130	70	70	120	300	870	1,580	16,400
1955	1,480	1,400	2,110	2,640	990	330	60	130	150	340	1,520	2,210	13,400
1956	2,810	1,880	4,480	7,680	2,870	190	30	80	120	350	1,520	1,940	24,000
1957	1,530	5,590	4,710	3,210	12,850	3,360	100	130	240	640	1,940	2,450	36,800
1958	2,270	5,100	5,420	8,370	6,980	240	60	160	240	460	1,830	2,640	33,800
1959	2,650	2,700	3,830	3,990	950	160	60	50	330	820	1,480	1,600	18,600
1960	1,500	1,740	6,390	6,090	570	60	20	100	110	260	450	1,300	18,600
1961	1,280	2,530	2,900	1,810	250	30	10	80	290	810	1,360	1,280	12,600
1962	1,150	23,330	7,830	9,980	3,930	240	50	60	80	380	1,100	1,480	49,600
1963	1,150	11,680	2,180	3,860	5,880	2,490	90	40	250	500	1,510	1,620	31,300
1964	1,570	1,440	1,700	8,290	10,500	5,100	480	100	120	370	1,740	7,070	38,500
1965	4,400	5,870	3,950	10,440	14,220	2,310	910	510	1,080	1,310	2,230	2,310	49,500
1966	2,250	1,920	5,830	6,200	1,070	80	10	20	50	220	790	1,370	19,800
1967	1,560	1,690	2,940	3,810	7,080	5,210	1,130	170	200	860	1,340	1,240	27,200
1968	1,370	3,320	4,870	3,960	2,290	1,350	100	850	440	760	1,780	1,770	22,900
1969	5,220	2,740	4,870	23,590	15,630	1,870	660	230	230	1,080	1,960	2,290	60,400
1970	4,600	2,810	3,250	3,140	9,840	3,580	220	190	470	1,220	2,200	2,340	33,900
1971	2,670	3,330	8,400	19,920	43,610	15,260	1,110	340	1,740	3,560	3,690	3,970	107,600
1972	4,930	4,760	22,370	25,800	29,570	7,980	780	720	1,410	3,030	3,530	2,980	107,900
1973	3,570	3,070	4,660	12,380	14,820	1,100	560	390	2,040	2,660	3,430	3,140	51,800
1974	3,240	2,810	13,860	22,430	26,510	3,700	390	380	430	1,650	2,940	2,750	81,100
1975	3,100	2,970	6,970	8,060	34,300	28,930	2,350	1,220	1,080	2,930	3,190	3,640	98,700
1976	2,600	2,480	5,770	22,680	36,980	4,050	370	630	940	2,470	2,420	2,290	83,700
1977	2,170	2,000	2,640	1,300	330	500	70	180	240	760	1,520	2,270	14,000
1978	2,370	2,590	6,040	12,510	11,360	2,110	170	140	570	1,020	1,710	1,760	42,400
1979	1,780	2,450	4,740	6,000	4,040	270	40	140	120	420	1,030	1,080	22,100
1980	7,070	8,940	4,690	9,020	22,170	10,920	440	170	420	1,480	1,870	2,120	69,300
1981	1,970	2,580	2,770	2,820	8,170	4,190	80	50	80	590	1,440	2,200	26,900
1982	1,700	3,180	6,290	13,780	37,060	10,550	1,800	510	1,680	3,310	3,130	2,830	85,800
1983	4,120	4,400	15,780	20,630	61,050	37,290	4,040	2,630	3,270	5,110	6,220	6,860	171,400
1984	7,370		9,480	23,450	108,290	53,480	5,350	3,090	4,660	5,060	6,130	6,400	239,000
1985	5,650	5,200	6,630	28,820	11,120	1,590	420	360	980	3,000	3,390	3,540	70,700
1986	3,650	16,460	29,740	40,110	37,250	8,770	1,140	2,200	6,350	6,410	5,070	4,060	161,200
1987	3,760	3,970	6,630	2,810	1,190	720	260	190	360	1,150	2,410	2,330	25,800
1988	2,430	2,500	4,080	2,810	510	120	70	60	70	200	720	1,430	15,000
1989	1,190	1,110	6,790	12,350	1,500	410	90	160	170	450	850	1,290	26,400
Average	2,920	4,350	6,500	10,930	15,670	5,800	630	460	850	1,540	2,270	2,620	54,500

Table 3.2-2

Table 3.2-2 (continued)
Computed Sediment Discharge (tons per month)
Snake River, Blackfoot Station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1950	2,100	3,120	5,490	26,380	44,320	107,930	50,020	1,350	3,900	7,160	8,420	7,660	267,900
1951	5,880	10,130	15,030	35,910	77,530	50,420	9,520	11,750	2,780	7,500	9,450	6,400	242,300
1952	6,220	8,870	12,390	46,810	106,850	59,810	5,700	1,010	740	990	3,970	4,720	258,100
1953	6,690	4,520	4,240	5,730	9,850	60,710	3,880	660	600	1,780	4,330	4,010	107,000
1954	3,660	3,360	3,660	8,550	45,170	24,010	14,720	830	880	2,900	4,500	3,160	115,400
1955	2,380	1,980	3,260	5,720	11,720	16,060	2,760	720	460	1,260	4,290	8,060	58,700
1956	6,390	2,610	9,730	51,930	91,470	110,120	6,900	1,030	870	3,330	4,970	3,790	293,100
1957	1,990	3,870	9,590	13,620	84,080	16,990	1,050	830	990	2,240	4,800	5,140	145,200
1958	4,050	4,430	4,210	6,990	29,100	8,000	560	810	1,180	610	3,830	3,860	67,600
1959	3,430	3,490	3,720	3,310	1,580	2,950	3,370	2,880	6,030	3,270	4,180	3,630	41,800
1960	2,060	1,850	3,330	4,210	1,670	2,320	1,590	6,730	3,530	950	1,900	1,680	31,800
1961	1,730	2,140	2,090	2,450	1,450	900	1,190	1,330	1,770	1,630	2,040	2,120	20,800
1962	1,560	6,290	2,680	16,440	36,940	10,140	2,320	1,230	1,040	1,400	2,740	4,270	87,100
1963	1,750	3,730	2,240	1,610	30,330	77,460	420	540	690	430	2,460	2,430	124,100
1964	1,670	1,660	2,750	17,070	61,140	73,910	13,900	1,100	730	1,660	4,080	5,980	185,700
1965	7,240	21,550	43,520	52,520	48,420	28,230	18,120	4,470	4,230	6,060	8,180	11,490	254,000
1966	6,990	6,690	6,130	8,110	18,790	2,490	1,170	8,890	4,150	1,700	2,350	2,870	70,300
1967	2,500	2,180	2,300	2,050	23,540	47,460	22,140	1,830	440	3,340	5,150	5,800	118,700
1968	5,150	3,160	3,390	7,710	22,080	41,680	1,360	9,400	1,700	3,040	5,190	8,180	112,000
1969	10,300	8,480	15,140	67,730	27,680	11,590	3,040	1,570	1,130	2,870	3,050	2,540	155,100
1970	3,240	3,110	3,040	11,780	72,250	57,000	18,480	1,310	3,600	3,920	6,550	7,450	191,700
1971	8,710	12,120	31,450	106,070	138,860	85,300	48,480	4,690	15,400	30,340	16,290	10,720	508,400
1972	9,750	12,780	44,210	96,170	65,410	72,210	5,000	5,250	10,240	14,840	11,040	12,000	358,900
1973	8,000	8,890	7,930	11,640	19,970	10,890	8,310	2,150	1,930	2,440	4,070	4,000	90,200
1974	5,320	6,360	20,690	99,650	89,880	78,710	22,630	2,230	1,190	6,580	9,620	8,580	351,400
1975	8,010	6,630	18,470	46,460	70,730	39,400	25,100	4,620	1,600	6,380	8,590	9,990	246,000
1976	10,210	9,670	29,360	82,320	149,100	58,710	3,850	5,320	2,360	3,920	5,040	10,700	370,600
1977	7,130	2,610	1,330	1,740	5,330	1,910	1,350	2,950	360	230	1,180	1,680	27,800
1978	1,710	1,640	4,260	22,670	42,890	22,840	6,970	1,950	1,790	710	3,810	7,550	118,800
1979	9,240	8,700	17,190	19,910	11,640	9,490	7,510	1,850	170	870	1,530	2,180	90,300
1980	2,360	2,660	2,170	12,090	50,200	61,080	4,100	1,680	640	1,220	2,180	2,150	142,500
1981	1,910	2,040	1,550	6,100	29,660	52,200	1,550	590	260	790	1,400	1,710	99,800
1982	1,400	2,330	21,810	48,550	100,070	37,580	43,590	4,800	5,660	13,060	12,080	12,190	303,100
1983	15,320	8,800	12,770	27,480	101,590	106,550	60,690	9,340	3,010	13,950	20,010	22,390	401,900
1984	21,310	9,420	12,710	59,420	125,810	142,960	53,930	17,450	12,690	10,770	12,440	17,310	496,200
1985	18,950	11,560	11,340	37,230	70,840	17,540	1,510	1,240	2,440	3,000	4,300	4,480	184,400
1986	7,370	7,850	55,350	99,200	125,480	103,180	21,760	2,450	8,560	9,560	10,560	13,990	465,300
1987	11,200	5,170	3,970	4,870	7,770	5,700	2,890	1,180	730	1,170	1,970	1,530	48,200
1988	1,560	1,240	1,290	2,170	1,070	1,810	3,610	3,340	1,980	780	1,880	1,180	21,900
1989	920	1,010	1,840	4,440	19,330	4,170	1,340	1,290	1,410	N/A	N/A	N/A	35,800
Average	5,930	5,720	11,440	29,620	51,790	43,060	12,660	3,370	2,850	4,580	5,750	6,400	183,200

Table 3.2-2 (continued)
Computed Sediment Discharge (tons per month)
Portneuf River, Tyhee Station

Table 3.2-2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1985	N/A	N/A	N/A	N/A	2,630	430	180	340	570	1,220	1,230	1,170	7,770
1986	1,230	3,270	5,480	7,260	6,570	1,570	410	840	1,640	1,950	1,630	1,400	33,250
1987	1,260	1,150	1,730	870	370	210	230	290	350	640	930	970	9,000
1988	980	980	1,250	930	280	50	100	150	170	340	530	730	6,490
1989	660	630	1,680	2,310	490	130	70	200	290	N/A	N/A	N/A	6,460
1990	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	440	590	640	1,670
Average	1,030	1,510	2,540	2,840	2,070	480	200	360	600	920	980	980	14,510

TABLE 3.2-3
HEC MODEL INPUT

MAJOR DRAINAGE	SUBDRAINAGE	SCS CURVE NUMBER	AREA (acres)	LAG TIME (minutes)(a)
SIM1	BANK1	75	535	18
	BANK2	75	231	18
	LGS	75	58.9	6
SIM2	PTB	73	81.9	18
	ROAD	75	29.5	6
	PSA	78	9.7	6
	OGS	75	13.4	6
	Plant	93	50.5	6
FMC1		71	114	11
FMC2		71	94	12
FMC3		93	28.5	7
FMC4		80	484	15
FMC5	Michaud	71	7488	164
	Local	71	1097	44
	Bannock	90	108.9	26

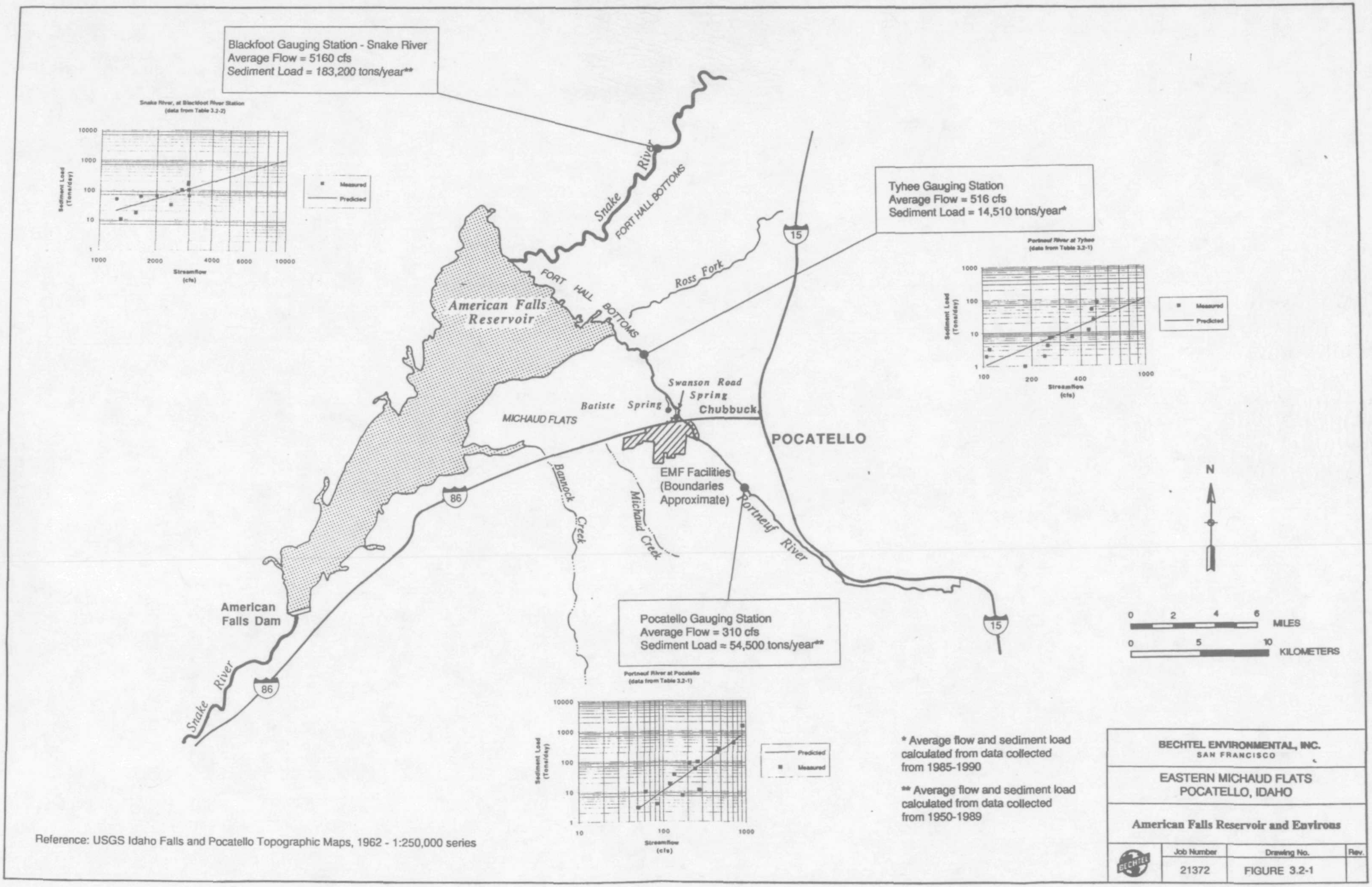
Note: (a) A minimum lag time of 6 minutes was used for small drainages.

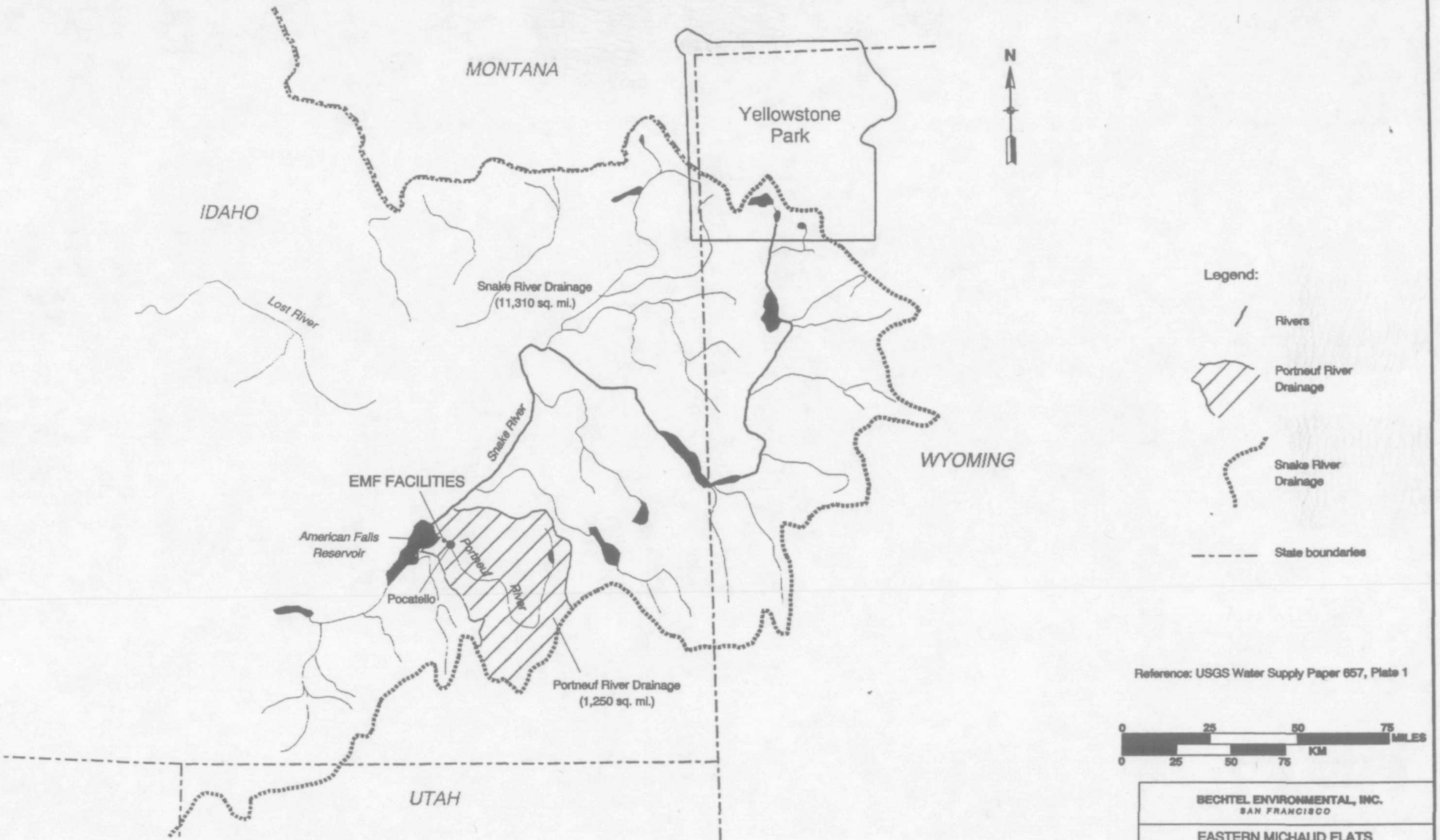
TABLE 3.2-4
RUNOFF VOLUMES FOR EVALUATED STORMS

DRAINAGE	AREA (ACRES)	24-HOUR, 2-YEAR STORM (1.15 IN.) (MG)	MAXIMUM OBSERVED 24-HOUR RAINFALL (mg)[(a)]	CONTAINED?
SIM1	825	1.30	6.70	Yes
SIM2	185	1.00	2.60	Yes
FMC1	114	0.09	0.62	Yes
FMC2	94	0.08	0.51	Yes
FMC3	28	0.44	0.89	Yes
FMC4	484	1.70	6.00	Yes
FMC5	8,694[(b)]	6.52	49.4	Yes

Notes: (a) Based on maximum 24-hour rainfall recorded at Pocatello Municipal Airport (1.82 inches, on October 2, 1976).
(b) Includes 7,488 acres from Michaud Creek drainage.

Surface and Subsurface Characterizations
Figures for Section 3.2


Blackfoot Gauging Station - Snake River
Average Flow = 5160 cfs
Sediment Load = 183,200 tons/year**
Sediment Load (Tons/day)
Streamflow (cfs)
Measured
Predicted
Snake River
FORT HALL BOTTOMS
Tyhee Gauging Station
Average Flow = 516 cfs
Sediment Load = 14,510 tons/year*
Ross Fork
15
American Falls Reservoir
Swanson Road Spring
Batiste Spring
Chubbuck
MICHAUD FLATS
POCATELLO
EMF Facilities
(Boundaries
Approximate)
Bannock Creek
Michaud Creek
Portneuf River
86
N
0 2 4 6 MILES
0 5 10 KILOMETERS
American Falls Dam
Snake River
Pocatello Gauging Station
Average Flow = 310 cfs
Sediment Load = 54,500 tons/year**
* Average flow and sediment load calculated from data collected from 1985-1990
** Average flow and sediment load calculated from data collected from 1950-1989
Reference: USGS Idaho Falls and Pocatello Topographic Maps, 1962 - 1:250,000 series
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
American Falls Reservoir and Environs
Job Number
21372
Drawing No.
FIGURE 3.2-1
Rev.

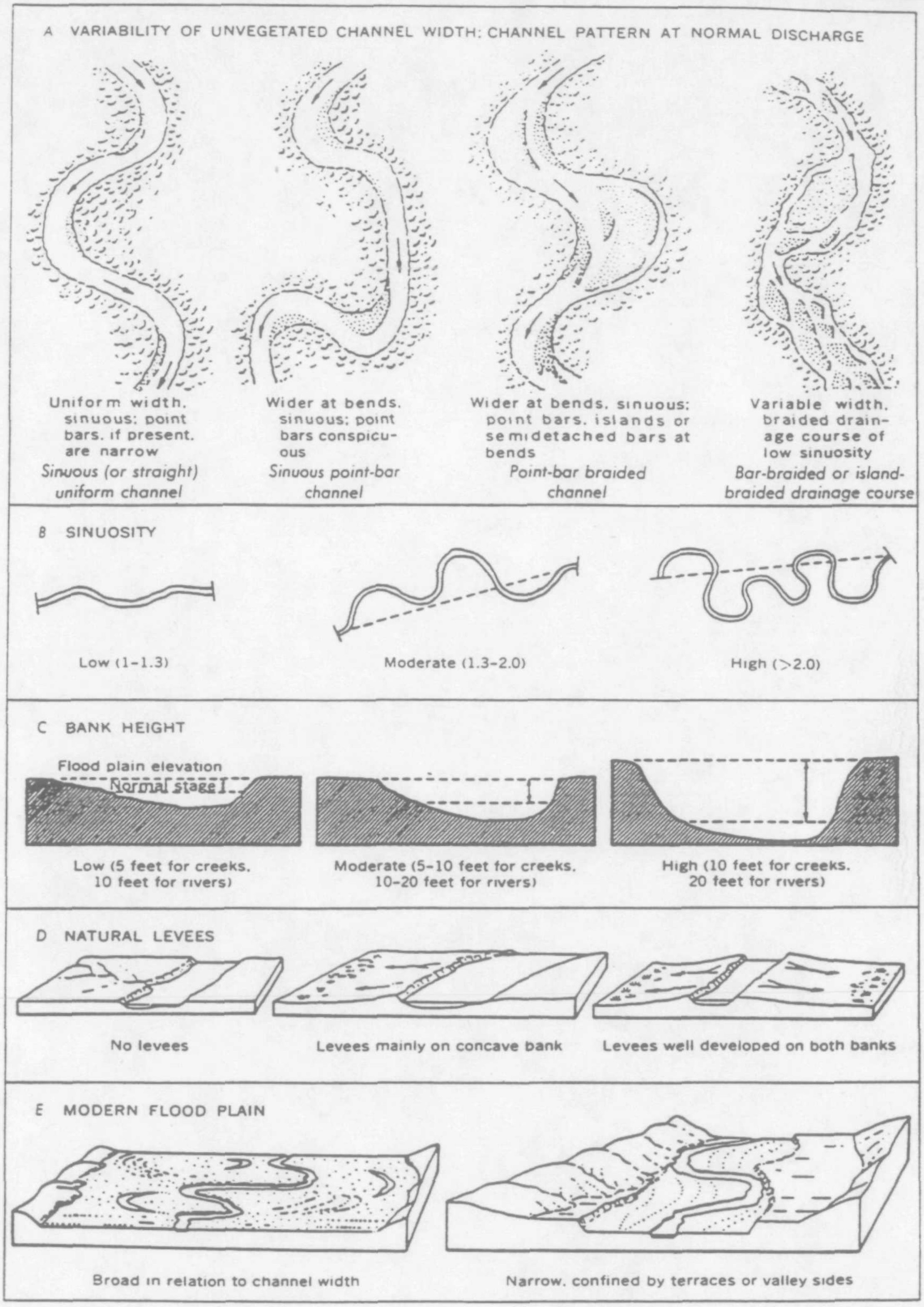


BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Drainage Basins of Snake and Portneuf Rivers

Job Number	Drawing No.	Rev.
21372	FIGURE 3.2-2	



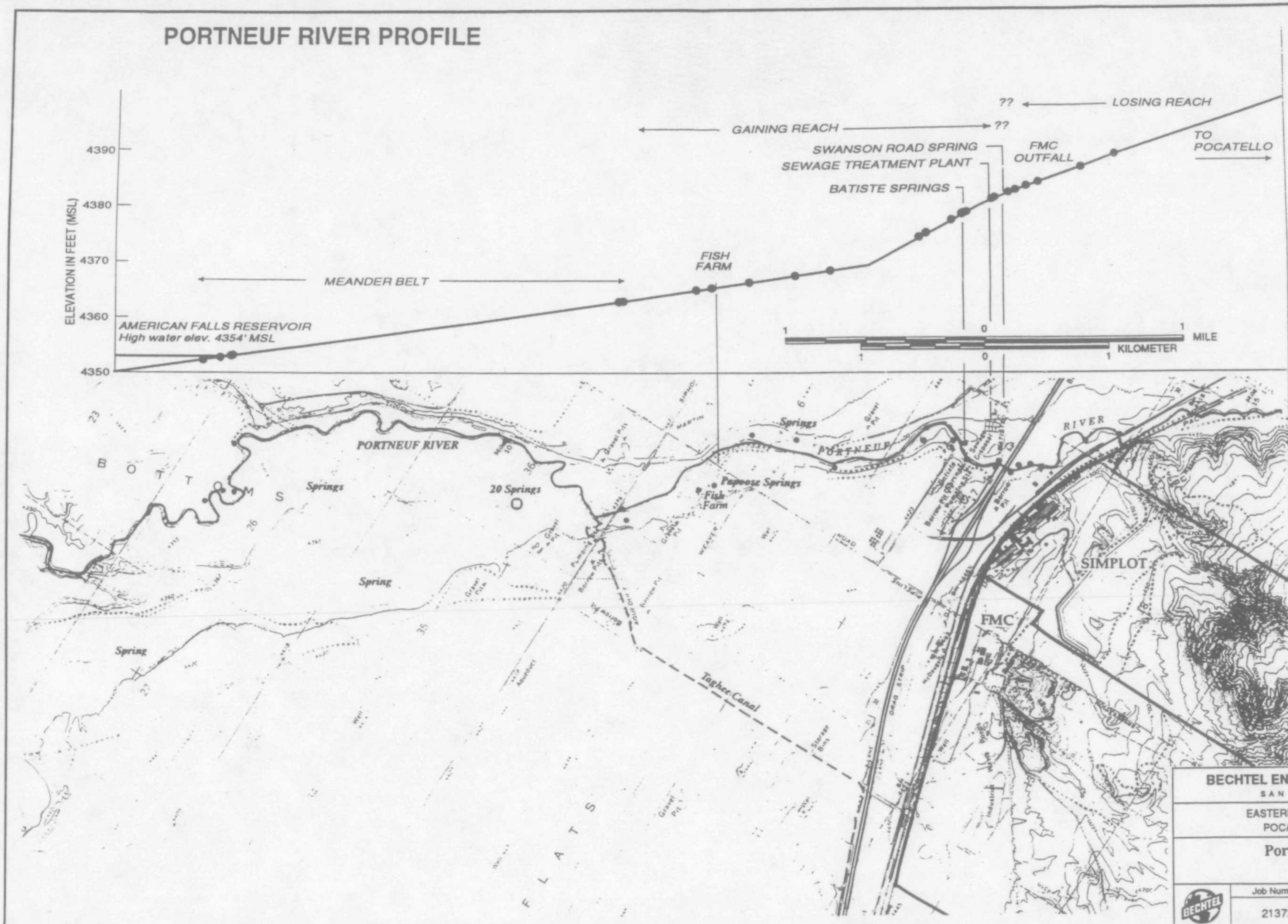
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Deposition Patterns in Streams

Job Number	Drawing No.	Rev.
21372	FIGURE 3.2-3	

Reference: U.S.G.S., "Fluvial Sediment Concepts", Book 3, Chapter C1,1970 (modified from Culbertson, Young, and Brice 1967).

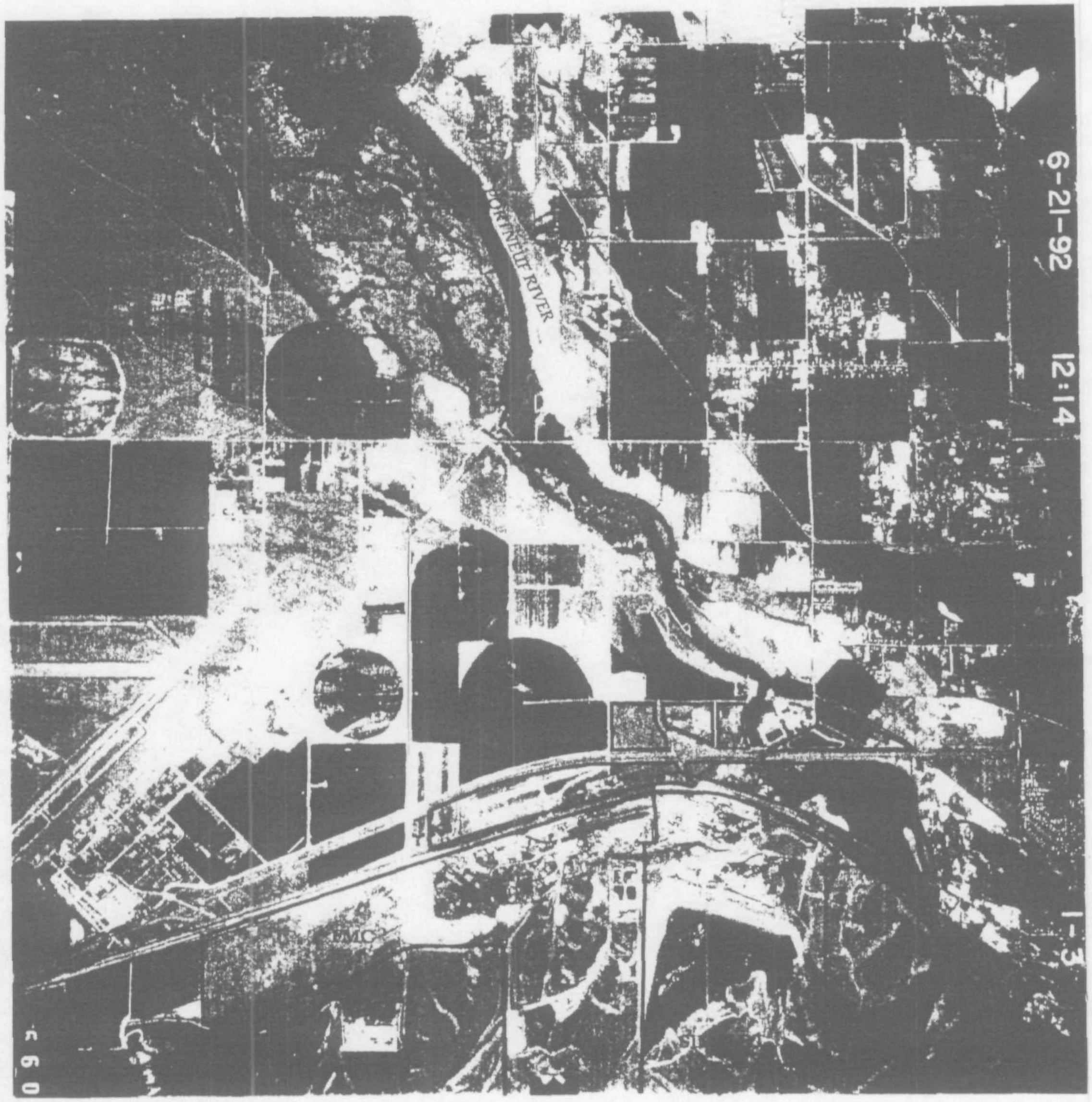


Legend:

● Sediment Sample Locations

Source: U.S.G.S. 7.5 unit topographic, Michaud, Idaho, 1974.

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Portneuf River Profile		
Job Number	Drawing No.	Rev.
21372	FIGURE 3.2-4	0



N

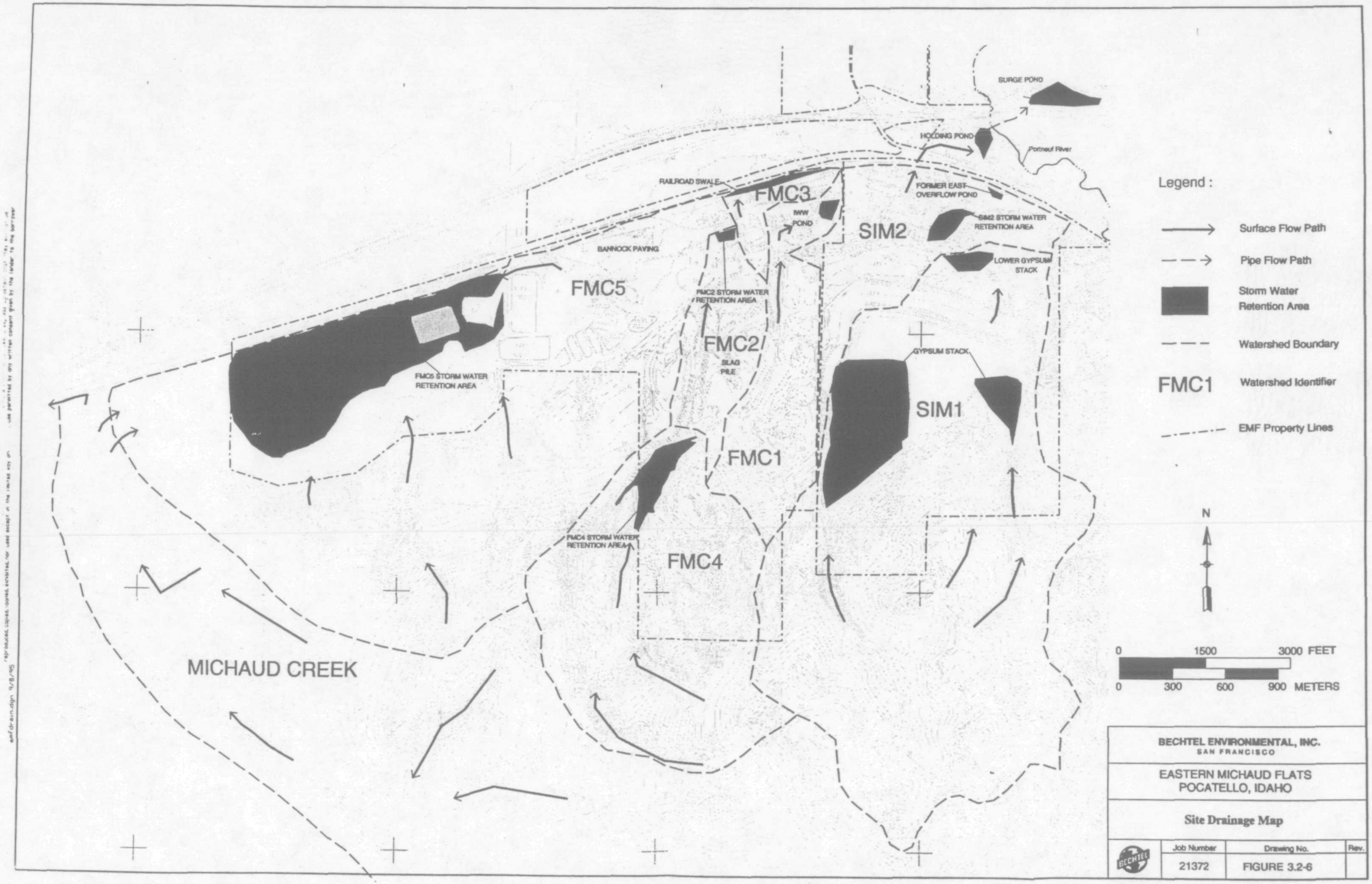
Legend:

——— EMF Property Lines

(Reference: Walker and Associates, 6/21/92)

0 0.5 1.0
SCALE IN MILES

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO	
EASTERN MICHAUD FLATS POCATELLO, IDAHO	
Aerial Photograph Showing Course of Portneuf River	
21372	FIGURE 3.2-5


SURGE POND
HOLDING POND
Portneuf River
RAILROAD SWALE
FMC3
FORMER EAST OVERFLOW POND
IWW POND
SIM2
SIM2 STORM WATER RETENTION AREA
BANNOCK PAVING
LOWER GYPSUM STACK
FMC5
FMC2 STORM WATER RETENTION AREA
FMC2
SLAG PILE
GYPSUM STACK
FMC5 STORM WATER RETENTION AREA
SIM1
FMC1
FMC4 STORM WATER RETENTION AREA
FMC4
MICHAUD CREEK
Legend :
Surface Flow Path
Pipe Flow Path
Storm Water Retention Area
Watershed Boundary
FMC1 Watershed Identifier
EMF Property Lines
N
0 1500 3000 FEET
0 300 600 900 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Site Drainage Map
Job Number
21372
Drawing No.
FIGURE 3.2-6
Rev.

3.3 HYDROGEOLOGY

This section presents a summary of the hydrogeologic data collected during the RI and draws on previous work to provide a clear picture of the primary hydrogeologic features associated with the EMF facilities and surrounding areas. A major part of the RI included the development of a numerical, three-dimensional, groundwater flow model. The conclusions drawn from the analysis of hydrogeologic data and the flow modeling study are presented in Figure 3.3-1. Further information on the development of the numerical model is presented in Appendix K.

The section contents and organization are as follows:

- Section 3.3.1 — Regional Hydrogeologic Setting
- Section 3.3.2 — Site Hydrogeology
  - Aquifer test results
  - Groundwater elevations, flow patterns, and vertical gradients
  - Water chemistry
  - Recharge and pumping rates
- Section 3.3.3 — Conceptual Groundwater Flow Model
- Section 3.3.4 — Numerical Modeling Results

3.3.1 REGIONAL HYDROGEOLOGIC SETTING

The Eastern Snake River Plain is underlain by basalt and gravel aquifers which are recharged mostly by underflow from surrounding mountain ranges. Some recharge occurs as irrigation return and deep percolation from precipitation. Several rivers flow onto the Snake River Plain, infiltrate underground, and the water ultimately discharges to the Snake River (Lost River on Figure 3.2-2). Groundwater flow through the basalts of the Snake River Plain occurs primarily in thin interflow zones: thin gravel and fracture zones between basalt flows and in the fracture of the basalts (some of the basalts are columnar basalts, with a large interconnected fracture network). Regionally, the Snake River defines the base level for other smaller rivers such as the Blackfoot and Portneuf Rivers. The Portneuf River drains approximately 1,250 square miles, Major groundwater for characteristics of the EMF study area, as shown by the potentiometric contour maps (Figures 3.3-8A through 3.3-8F) and study area particle tracking results (Figures 3.3-14 through 3.3-17), are as follows:

- Northward flow from the western and central portions of the EMF facilities is limited to the area south of I-86 by converging flow of groundwater from the west and northwest.
- Groundwater from the western and central portions of the EMF facilities is swept eastward, south of I-86, and joins groundwater from the joint fenceline area and from Simplot.
- In the joint fenceline area, groundwater from the western part of the gypsum stack flows in a northwesterly sweeping arc across the Simplot property boundary, flows beneath FMC in the area of Well 142, where it commingles with flows from the eastern portions of FMC, and exits from the plant boundaries to the northeast.
- Virtually all groundwater underflowing the EMF facilities discharges to the Portneuf River at Batiste and Swanson Road Springs and as a baseflow in the reach bounded by these springs.

FIGURE 3.3-1
OVERVIEW OF GROUNDWATER FLOW PATTERNS

flowing across the Eastern Michaud Flats to the American Falls Reservoir, where it joins the Snake River (Figures 3.2-1 and 3.2-2).

The Michaud Flats are underlain by the same prolific basalt and gravel aquifers. These aquifers are recharged by underflow from the adjoining Bannock and Pocatello mountain ranges and from significant downvalley underflow from the Pocatello Valley aquifer. Smaller drainages also provide underflow to the aquifers (Figure 3.3-2). Direct infiltration from precipitation and irrigation return are other recharge sources. Within the mountainous areas, there are no regionally continuous hydrostratigraphic units. Groundwater flows through undifferentiated volcanic and sedimentary rock units, with flow focused to sediment-filled valleys incised into the mountains. At the transition between mountainous areas and flatlands, there are alluvial fan deposits where groundwater flow occurs primarily within sand and gravel lenses.

Within the Michaud Flats, the aquifer system can be divided into a shallow aquifer and a deeper aquifer. The shallow aquifer is Michaud Gravel which is typically is overlain by a silt aquitard, but is locally unconfined. The deeper aquifer is comprised of the gravel and volcanics of the Sunbeam and Starlight Formations, and the Big Hole Basalt. The deeper aquifer is the primary water-producing aquifer within the Michaud Flats. The deeper aquifer underlies the American Falls Lake Beds (AFLB), the regional aquitard between the shallow and deeper aquifers (Houser, 1992). Groundwater that flows into the regional aquifer system discharges to the Portneuf River (via springs and base flow contribution), American Falls Reservoir, or to one of the numerous springs and seeps in the Fort Hall Bottoms. Agricultural, industrial, and domestic water supply wells extract groundwater from the regional aquifer.

Groundwater discharges to the Portneuf River along the reach from I-86 downstream to the American Falls Reservoir. The river gains approximately 200 cfs flow along this reach as groundwater discharges through the riverbed and springs. The STP contributes some flow along this river reach.

3.3.2 Site Hydrogeology

Geologic borings were drilled and logged, monitoring wells were installed, pumping well flow rates were measured, and groundwater chemistry data were collected as part of the RI. Numerous slug tests and pumping tests were also performed as part of this aquifer characterization. Additional hydrostratigraphic data and aquifer testing results were acquired from other sources, including Jacobson (1982, 1984, and 1989), Goldstein (1981), and the City of Pocatello.

The local hydrostratigraphic framework is generally consistent with the regional framework. Three distinct hydrogeologic areas were delineated in the vicinity of the EMF facilities on the basis of lithologic data, stratigraphic relationships, groundwater flow characteristics, and water chemistry. These areas are the Michaud Flats, Bannock Range, and Portneuf River (Figure 3.3-3). Within the Bannock Range area there were no continuous hydrostratigraphic units delineated during the RI. Starlight Formation volcanic flows and interflow units are not correlative, and the overall distribution of rock types and saturated materials is best described as highly heterogeneous.

The transition zone between the Bannock Range hydrogeologic area and the Michaud Flats is characterized by small coalescing alluvial fans that are also relatively heterogeneous. In the Michaud Flats, distinct shallow aquifer and deeper aquifer zones were identified in the RI (Figure 3.3-4). The shallow aquifer is a 10 to 20-feet thick gravel and sand aquifer that is locally overlain by a silt aquitard (Figure 3.3-5). The deeper aquifer is the gravel unit of the Sunbeam Formation and the underlying basalt and rhyolite. The unconsolidated gravel and the underlying volcanic lithologies do not appear to have a large permeability differential, nor is there an intervening aquitard between these units. Therefore, both units constitute the deeper aquifer in the Michaud Flats area.

The American Falls Lake Beds form an aquitard that separates the shallow and deeper aquifers within the Michaud Flats area. These lacustrine clays and silts have very low permeability and are regionally extensive, extending from the Bannock Range area to the American Falls Reservoir, where they crop out along the reservoir embankment. The AFLB are not present along part of the Portneuf River in the area of Batiste Springs and Wells 524/525 south to Well 520 (Figure 3.3-6). The Bonneville Flood may have scoured the AFLB, consistent with Trimble's (1976) map of boulder deposition patterns that indicate a main flood channel in this area. Elevation contours on the top of the AFLB suggest a slight dip to the north. Just to the south of I-86, there is an elongated, east-west depression in the AFLB surface, which may also be an erosional feature of the flood (Figure 3.3-6).

In areas immediately adjacent to the Portneuf River where the AFLB are not present (as discussed above) and in the Bannock Range area, the delineation of distinct shallow and deeper aquifers was not possible. In the Bannock Range and Portneuf River areas, the monitoring wells in well pairs were classified as shallow and deep without respect to specific hydrostratigraphic units.

3.3.2.1 Aquifer Test Results

Pumping test and slug test results are summarized in Table 3.3-1. Calculated hydraulic conductivities in the shallow saturated zones are shown in Figure 3.3-7a. Results for the deeper zones are summarized in Figure 3.3-7b.

In the Bannock Range area, hydraulic conductivity typically ranges from 0.00001 cm/s (0.03 ft/day) to 0.099 cm/s (28 ft/day) in shallow and deeper zones. Although the lithology is highly heterogeneous, the hydraulic conductivity is fairly consistent throughout much of this area as defined by Wells 142, 300, 301, 304, 306, 323, 325, PEI-2, and PEI-5. Hydraulic conductivities are higher at Wells 307, 308 and 333, which are located along the joint fenceline of Simplot and FMC. The higher hydraulic conductivities in this area are associated with a small, narrow, and deep relict sediment-filled stream channel originating within the Bannock Range (Figures 3.3-2 and 3.3-7a).

Hydraulic conductivity in the Michaud Flats shallow aquifer ranges from 0.0105 cm/s (30 ft/day) to 0.355 cm/s (1,000 ft/day). The highest values were at Wells 150 and 153. Slightly lower values were associated with the depression in the AFLB, and two of the lowest values were measured in Wells 515 and 516, north of this depression. In the deeper aquifer hydraulic conductivities appear to have an increasing trend to the north. Relatively low values were measured in deeper Wells 103 and 107 with slightly higher values at Well 500 and 133.

Transmissivity data from Jacobson (1984) indicate very high hydraulic conductivities in the deeper aquifer throughout the area north of I-86 (Table 3.3-1). South of I-86, a transmissivity of 227,000 square feet per day (ft^2/day) was calculated at Simplot production well SWP-7. SWP-5 has a higher transmissivity than SWP-7 as indicated by the pumping test. When SWP-5 was installed and developed, 3 feet of drawdown was measured after 48 hours of pumping at 4,100 gpm. Irrigation wells tested in the Michaud Flats had transmissivities ranging from 21,900 to 444,000 ft^2/day (Jacobson, 1984).

The bouldery gravel aquifer in the Portneuf River area has the highest hydraulic conductivity. Calculated values ranged from 0.01 cm/s (28 ft/day) to 1.7 cm/s (4,800 ft/day). Most of the slug test results from the Portneuf River area indicate hydraulic conductivities are greater than 0.36 cm/s (1,000 ft/day). Hydraulic conductivities appear to be similar in the shallow and deeper wells throughout the Portneuf River area.

3.3.2.2 Groundwater Elevations, Flow Patterns, and Vertical Gradients

Depth to groundwater in wells ranged from over 150 feet in the Bannock Range to less than 10 feet near the Portneuf River. The groundwater elevations in the Bannock Range were up to 4,629 feet (above mean sea level), as measured in PEI-1. Approximately 8,500 feet north the groundwater elevations were 4,383 feet msl at Batiste Spring along the Portneuf River (Figure 3.3-8F).

There are seasonal water level fluctuations in the Michaud Flats, typically on the order of 2 to 4 feet, which may be associated with irrigation withdrawal and recharge patterns (Appendix K). In the Portneuf River area seasonal fluctuations are typically less than 1 foot (Appendix K). Long-term groundwater levels in the Michaud Flats appear to have declined on the order of 2 to 3 feet since the 1950s (Jacobson, 1982); however, Goldstein (1981) reported increasing and decreasing trends in various wells in Michaud Flats, indicating that long-term groundwater levels are regionally stable with possible local variations. Data from EMF monitoring wells indicate no long-term decrease in water levels from 1981 through 1994 (Appendix K).

Groundwater elevation contour plots for the shallow saturated zone were made for each sampling event from June 1992 through August 1993 and June 1994 (Figures 3.3-8A through 8F). These contour patterns are very consistent from quarter to quarter, and are similar to groundwater elevation contours from 1981 (Geraghty and Miller, 1982). Several key features are evident in the contour patterns.

- There are very steep horizontal gradients in the Bannock Range.
- Within the westernmost part of the monitoring network, there is a slight northwest-trending trough in the groundwater surface defined by these wells.
- Another trough is seen along the Portneuf River, east of Simplot.
- There is a distinct increase in the horizontal gradient in the vicinity of Wells 112 and TW-9S, and a decreasing gradient further east, in the vicinity of Wells TW-9S and TW-11S.
- Shallow groundwater contour patterns do not appear to be influenced by production wells pumping from the deeper aquifer.

General flow patterns described by the hydraulic head contours indicate that groundwater flows north off the Bannock Range under steep gradients through low permeability lithologies (Figures

3.3-3 and 3.3-8A through 3.3-8F). When this Bannock Range flow enters the highly permeable Michaud Flats and Portneuf River lithologies, groundwater flow converges sharply, with all shallow Bannock Range groundwater ultimately discharging along a short reach of the Portneuf River bounded by Batiste Spring to the north and I-86 to the south.

Horizontal groundwater seepage velocities, calculated from hydraulic conductivities, horizontal gradients, and estimated porosity, are up to 12 feet per day (ft/day) in the Portneuf River area, 0.4 ft/day in the Bannock Range area, and from 1 to 11 ft/day in the Michaud Flats area. The variable seepage velocities calculated in the Michaud Flats area illustrate the effects of variable horizontal gradients and the wide range of hydraulic conductivities calculated for this area (Table 3.3-1). The consistently high seepage velocities in the Portneuf River area are indicative of the very high hydraulic conductivities associated with the Bonneville Flood deposits. Groundwater fluxes are discussed Section 3.3.4.

One set of data from deeper wells was contoured to illustrate the general contour patterns in the deeper saturated zones (Figure 3.3-9). The general contour patterns are similar to the shallow saturated zone in many respects. For example, there is sharp convergence of flow to the Portneuf River reach from Batiste Spring to I-86. The increase in horizontal gradient from the area of Well 112 to TW-9S is not evident in the deeper groundwater contours. The effects of the EMF production wells are not readily apparent in the contours developed from deeper groundwater monitoring wells. This is likely due to very high transmissivity in the deeper aquifer and the minor drawdown associated with production well pumping.

Vertical head differentials were measured in well pairs installed during the RI and during previous investigations. Vertical head differentials are one measure of the flow potential between shallow and deeper saturated zones. (The other factor is the vertical hydraulic conductivity.) The vertical head differentials also provide indications of the direction of the flow or gradient between shallow and deeper zones.

The overall pattern of vertical differentials shows that in the area along the flanks of the Bannock Range there is a downward flow potential (Figures 3.3-10A through 3.3-10I). Well pairs 130/137 and 101/102 have persistent downward gradients, and well pair 103/104 has a slight upward gradient (less than 0.10 foot head differential). Further north, vertical gradients are upward in well pairs 134/133, 117/118, 107/108, TW-5S/TW-5I, and 500/501. There is a downward gradient measured in well pair 125/126, located near production well FMC-1, which draws water from the deeper aquifer and probably induces a local downward gradient.

From the area along the joint facilities' fenceline out to the Portneuf River, there are large upward vertical head differentials measured in the well pairs 309/310, 329(311)/312, 109/110, 319/320, TW-11I/11S, 504/505, 503/519, and 315/316. In these well pairs the water levels in the deeper wells are typically 2 to 6 feet higher that water levels in the shallow wells. In well pairs 508/509, 506/507, 510/511, located along the Portneuf River south of 504/505, the vertical head differentials are less than 0.10 foot. During several monitoring events, there were minor (0.07 foot) downward head differentials measured at well pair 510/511. The change from very small upward and downward head differentials in the Portneuf River well pairs to large head differentials in 504/505 coincides with the area where the river transitions from a losing stream to a gaining stream.

The slight downward gradient at the 524/525 well pair is not inconsistent with groundwater discharge to the Portneuf River through springs and as baseflow. In contrast with other well pairs to the south, a very slight (.04-.06 foot differential) downward vertical gradient exists at the 524/525 well pair, which is just north of the groundwater discharge areas at Batiste Spring, Swanson Road Spring and the Portneuf River. Adjacent wells 524 (deep) and 525 (shallow) are screened at depths of 48.5-58.5 and 17.8-27.8 feet below ground, respectively, within silty gravel deposits. No confining beds are present.

The slight vertical gradient at this location indicates that horizontal flow is dominant within the shallow gravel interval penetrated by both wells. The well pairs to the south have a greater vertical separation between screened intervals. This indicates that the vertical gradients are more prevalent between the very deep (>90 feet bgs) and the shallow (<60 feet bgs) gravels near the river.

3.3.2.3 Water Chemistry

Groundwater samples were collected from 17 monitoring wells beyond the potential influence of the EMF facilities (Section 4.4). These wells were used to characterize aquifer water chemistry in the three hydrogeologic areas. Three hydrogeochemical regimes were identified, although the extent of these regimes is not always correlative with the hydrogeologic areas (Figure 3.3-3). These regimes are the Portneuf River, Bannock Range, and Michaud Flats hydrogeochemical regimes. The general water chemistry of these regimes is illustrated in Stiff and Piper diagrams for the selected wells in Figures 3.3-11 and 3.3-12A through 3.3-12D. These figures illustrate two points: first, water chemistry in the Michaud Flats regime is distinctly different than either the Bannock Range or Portneuf River regimes, and second, the water chemistry of the Portneuf River is distinct from the Bannock Range, albeit the differences are more subtle.

The predominant regional groundwater type is the calcium-bicarbonate chemistry of the Bannock Range regime, with localized areas in the Michaud Flats and Portneuf River having a distinct "overprint" from local recharge sources. The shallow aquifer beneath the Michaud Flats has a higher sodium and chloride content than Bannock Range and Portneuf River Valley groundwater. The salinity of the Michaud Flats shallow aquifer is probably due to irrigation. The higher alkalinity in wells near the Portneuf River (among other minor differences such as higher barium and lower arsenic concentrations) is likely due to river water that is lost to the aquifer along the losing reach of the Portneuf River.

The Bannock Range water chemistry is evident in the deeper aquifer beneath the Michaud Flats, within the Bannock Range, and extends to the Portneuf River. Portneuf River Valley groundwater discharges at Swanson Road Spring, whereas Bannock Range groundwater discharges at springs further north (Figure 3.3-3).

3.3.2.4 Recharge Rates and Pumping Rates

The estimated recharge rate in the Eastern Snake River Plain is 10 percent of the mean annual precipitation (Wood and Low, 1986). Based on a mean annual precipitation at the Pocatello Airport of 10.9 inches, the average recharge is about 1 inch per year. There are slightly higher recharge rates in the Bannock and Pocatello Ranges due to greater mean annual precipitation at the higher elevations, and because more of it occurs as snow.

In the Michaud Flats and Portneuf River area, a large percentage of the land is used as irrigated cropland for potatoes, alfalfa and grain. Potatoes and alfalfa have fairly high water demand, with about 30 to 40 inches of irrigation water applied annually to these crops. Additional recharge to the shallow aquifer as a result of irrigation in the Michaud Flats may be up to several inches per year.

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Major EMF-related recharge areas identified during the RI included the former east overflow pond (closed in August 1993), former Pond 8S (filled in September 1994), the gypsum stacks, and the IWW ditch. In these areas, annual recharge may be much greater than the background average of 1 inch per year.

Withdrawal rates for irrigation wells throughout the Michaud Flats are approximately 1,000 gpm (Jacobson, 1984; Goldstein, 1981), and numerous domestic wells pump less than 50 gpm. The FMC production wells have a total combined flow rate of approximately 875 gpm. Extraction from Simplot production wells is about 3,300 to 4,000 gpm combined flow. Extraction rates at each of the three Simplot production wells (SWP-6 is a standby production well) may vary depending on specific production needs, but the average total flow is relatively constant.

The Simplot and FMC production wells are located in the Michaud Flats and Portneuf River areas, and are screened below the AFLB in the deeper aquifer. The perforated interval in Simplot production well SWP-4 extends into a shallow saturated gravel; however, the nearby piezometer 334 indicates there was no measurable drawdown in the shallow aquifer when SWP-4 was operating (Figure 3.3-13). Sulfate concentrations in SWP-4 further indicate that this well was not extracting a significant proportion of water from the shallow gravel unit.

3.3.3 Conceptual Groundwater Flow Model

Groundwater flows north off the Bannock Range under steep hydraulic gradients through volcanic and sedimentary rocks of low hydraulic conductivity. There appear to be preferential flowpaths associated with interflow gravel and sand deposits and within sediment-filled valleys. The source of this flow is recharge from small watersheds within the Bannock Range. Groundwater flow from the Bannock Range represents a very small fraction of the total water budget for the Michaud Flats and Portneuf River aquifer system.

Groundwater exits the Bannock Range and enters the Michaud Flats in the western FMC area where it mixes with groundwater in the shallow aquifer of the Michaud Flats. The Bannock

Range groundwater flows into the shallow Michaud Flats aquifer because upward vertical gradients and intervening aquitards prevent downward flow. The Michaud Flats groundwater flows east-southeast, away from a regional groundwater divide located further north within the Michaud Flats (Jacobson, 1982). There is a mixing zone within the western FMC area where the more saline shallow Michaud Flats water mixes with the Bannock Range groundwater. As the commingled groundwater flows toward the east-northeast, additional Bannock Range groundwater is introduced by upward flow and lateral flow from the south, diluting any Michaud Flats chemical signature.

Groundwater flowing northwest through the Portneuf River area parallels the axis of the Pocatello Valley out to the Michaud Flats, then groundwater flow is deflected west near the region where the AFLB pinch out. The source of this downvalley underflow is recharge from the Bannock Range and Pocatello Range that make up the Portneuf River watershed.

Some of the downvalley underflow discharges to the river and springs, some bypasses the river and underflows the river channel near the Simplot facilities, only to discharge to Swanson Road Springs and the river. Some of the groundwater from the valley bypasses the river near the Indian Springs Trout Farm and Rowlands Wells. This occurs because the AFLB are present here, and only a portion of the groundwater discharges through this very low permeability aquitard to the river. Groundwater that bypasses the river underflows into the Michaud Flats, and eventually discharges to the springs, the reservoir, or is extracted at wells west of the river.

3.3.4 Numerical Modeling Results

A numerical modeling study was performed to quantitatively test relationships between the hydrogeologic data and to refine the understanding of groundwater flow patterns relative to EMF activities (Bechtel, 1994). The numerical model was also used to evaluate the effects on groundwater flow patterns associated with EMF facilities operations (active recharge from former Pond 8S and the gypsum stack and pumping from production wells) compared to no

EMF-related operations.

The detailed derivation of the model input parameters, discretization of the flow model domain, and selection of the computer codes are presented in Appendix K. This section presents a summary of the flow modeling results and key findings.

The numerical model simulated the general flow patterns interpreted from the groundwater elevation contours and geochemical data. In the Michaud Flats area, converging flow patterns were evident in the shallow aquifer associated with the east/west trending depression in the AFLB and the 4,392 to 4,396 feet groundwater elevation contours (Figures 3.3-8F and 3.3-14). Modeled flowpaths in the Portneuf River area were consistent with flowpaths interpreted from contoured water elevation data and from water quality data. In the Bannock Range area, where there was limited data for accurately defining hydrogeologic properties and the locations of potential preferential pathways, the modeled flowpaths provided a conceptual representation of estimated groundwater flow patterns. Because actual flowpaths through the Bannock Range are not well-defined by data, and model calibration targets were not achieved in the Bannock Range area, the modeling results are only crude approximations of groundwater flow patterns.

Active EMF operations were simulated for the period of the RI (1992 through 1993). These operations included recharge at the gypsum stacks and Pond 8S and groundwater extraction at the FMC and Simplot production wells. Simulated groundwater levels and flow patterns during active EMF operations confirm that the Simplot and FMC production wells have little or no discernible effect on the shallow saturated zone (Figures 3.3-14).

Particle tracks within the deeper saturated zone were also generated from the flow model, as presented in Figure 3.3-15a. These tracks indicate that groundwater flowing north from the Bannock Range in the deeper aquifer (the green track lines, corresponding to Model Layer 4) is ultimately captured by the FMC and Simplot production wells. This occurs within most of the Bannock Range in the study area, except for the easternmost area of the Bannock Range. Flow in the deep aquifer in this eastern area migrates upward into the shallow aquifer in the area north of Highway 30 (as noted by the transition from green to blue track lines in Figure 3.3-15a), and flows northeasterly toward the Portneuf River between Batiste and Swanson Road Springs.

Although the particle tracks indicate very broad capture zones to the south of the EMF production wells, the actual proportion of flow supplied to these wells from the Bannock Range area is relatively small. The combined flow rates of the EMF production wells is approximately 3,750 gpm (8.3 cfs) and the underflow through the Bannock Range in the deeper aquifer is approximately 1 cfs.

The primary calibration target for the numerical flow model was the measured river gain from I-86 north to Station 10 (Figure 3.3-2). Measured spring discharges were also calibration targets. Since the simulated discharges met the calibration targets, water fluxes within the other parts of the model domain were assumed to reflect actual conditions. Based on this, the following water budget for the model study area was compiled.

About 78 to 110 cfs discharges to the Portneuf River between I-86 and sampling station 10 to the north (Figure 3.3-2). The model output indicated a discharge of 74 cfs to the Portneuf River over the same reach. Measured discharge at Batiste Spring was 5.7 cfs (Perry, 1990) and 4.7 cfs at Swanson Road Spring (June 1994). The Batiste Spring channel discharge was 12 cfs as measured in June 1994 as part of this study. Simulated spring discharges were within the calibration criteria (Appendix K).

Model output shows approximately 3.5 cfs underflows the study area through the southern boundary, or less than 5 percent of the total water budget for the model domain. This modeled underflow through the Bannock Range may be overestimated since the recharge from contributing watersheds is estimated to be less than 3.5 cfs. Regardless, this underflow, combined with recharge within the EMF facilities portion of the model domain, is the primary limiting factor for the flux of groundwater underflow through the EMF facilities.

Westward flow into the model domain is approximately 55 cfs. Some of this underflow is water that is lost to the aquifer by the Portneuf River. The river gaging results indicate the Portneuf River does not lose water to the aquifer at a very high rate, which agrees with the observations that the river channel and banks are silty, relatively low permeability materials. A low river loss to the aquifer limits the extent of the Portneuf River Valley hydrogeochemical regime.

There is a flow contribution of less than 2 cfs through the shallow aquifer within the Michaud Flats, thus illustrating why the Michaud Flats chemistry is diluted by the regional Bannock Range chemistry as they mix and flow toward the river (Figure 3.3-3).

One model scenario investigated the potential changes to groundwater flow patterns associated with cessation of operations at Simplot and FMC. EMF-related recharge sources were assumed to contribute no more than background recharge rates, and EMF production wells were assumed no longer in operation. The resulting groundwater flow patterns illustrate the overriding influence on groundwater flow patterns exerted by the strong hydraulic sink associated with the gaining reach of the Portneuf River from I-86 north to Batiste Spring (Figures 3.3-16 and 3.3-17). The model simulation does not predict major shifts in flow patterns in the shallow saturated zone in the area north of the gypsum stack. In the deeper saturated zone, there were significant changes in the flow patterns as the EMF production wells ceased capturing most of the deeper underflow through the Bannock Range. The Bannock Range groundwater discharges to the river at the hydraulic sink associated with Batiste and Swanson Road Springs.

When the EMF facilities cease operations, there will be a net reduction in groundwater extraction of approximately 4,200 to 5,000 gpm (10 cfs) at the EMF production wells. Most of this 10 cfs groundwater will discharge to the Portneuf River.

Surface and Subsurface Characterizations
Tables for Section 3.3

TABLE 3.3-1

TABLE 3.3-1
HYDRAULIC CONDUCTIVITIES AND TRANSMISSIVITIES OF EMF AQUIFER SYSTEM

	Shallow Wells	Hydraulic Conductivity cm/s	Hydraulic Conductivity ft/day	Type of Test	Source
MICHAUD FLATS	104	4.45E-02	126	Slug Test	BEI
	108	1.01E-01	286	Slug Test	BEI
	110	3.80E-02	108	Slug Test	BEI
	111	1.40E-01	397	Slug Test	BEI
	113	1.40E-01	397	Pumping Test	BEI
	126	5.85E-02	166	Slug Test	BEI
	134	1.09E-01	309	Slug Test	BEI
	135	3.15E-02	89.3	Slug Test	BEI
	139	1.90E-02	53.9	Slug Test	BEI
	140	9.70E-02	275	Slug Test	BEI
	146	6.10E-02	173	Slug Test	Hydrometrics
	148	2.45E-02	69.5	Slug Test	Hydrometrics
	150	3.55E-01	1000	Pumping Test	BEI
	153	3.30E-01	935	Slug Test	BEI
	154	1.74E-02	49.3	Slug Test	Hydrometrics
	501	9.05E-02	257	Slug Test	BEI
	514	3.92E-02	111	Slug Test	Hydrometrics
	515	1.05E-02	29.8	Slug Test	Hydrometrics
	516	2.33E-02	66.0	Slug Test	Hydrometrics
BANNOCK RANGE	106	4.30E-03	12.2	Slug Test	Hydrometrics
	142	7.00E-04	1.98	Slug Test	BEI
	300	2.43E-04	0.69	Slug Test	Hydrometrics
	301	1.00E-05	0.03	Slug Test	BEI
	304	4.95E-04	1.41	Slug Test	Hydrometrics
	306	1.17E-03	3.32	Slug Test	Hydrometrics
	307	9.91E-02	281	Slug Test	Hydrometrics
	308	2.51E-02	71.2	Slug Test	Hydrometrics
	313	1.80E-02	51.0	Slug Test	BEI
	316	1.02E-02	28.9	Slug Test	BEI
	323	1.20E-03	3.40	Slug Test	Hydrometrics
	325	5.45E-03	15.5	Slug Test	BEI
	333	9.91E-03	28.1	Slug Test	Hydrometrics
	PEI-2	1.00E-03	2.83	Pumping Test	PEI
	PEI-5	4.50E-04	1.28	Pumping Test	PEI
PORTNEUF RIVER	312	1.40E+00	3970	Pumping Test	BEI
	318	1.40E-03	3.97	Slug Test	BEI
	324	5.45E-02	154	Slug Test	BEI
	327	1.18E-01	334	Slug Test	Hydrometrics
	328	1.84E-01	522	Slug Test	Hydrometrics
	502	1.39E-01	394	Slug Test	Hydrometrics
	503	1.68E+00	4760	Slug Test	BEI
	505	3.66E-01	1038	Slug Test	Hydrometrics
	507	6.40E-01	1810	Slug Test	BEI
	517	7.20E-01	2040	Slug Test	BEI
	518	1.49E-01	422	Slug Test	Hydrometrics

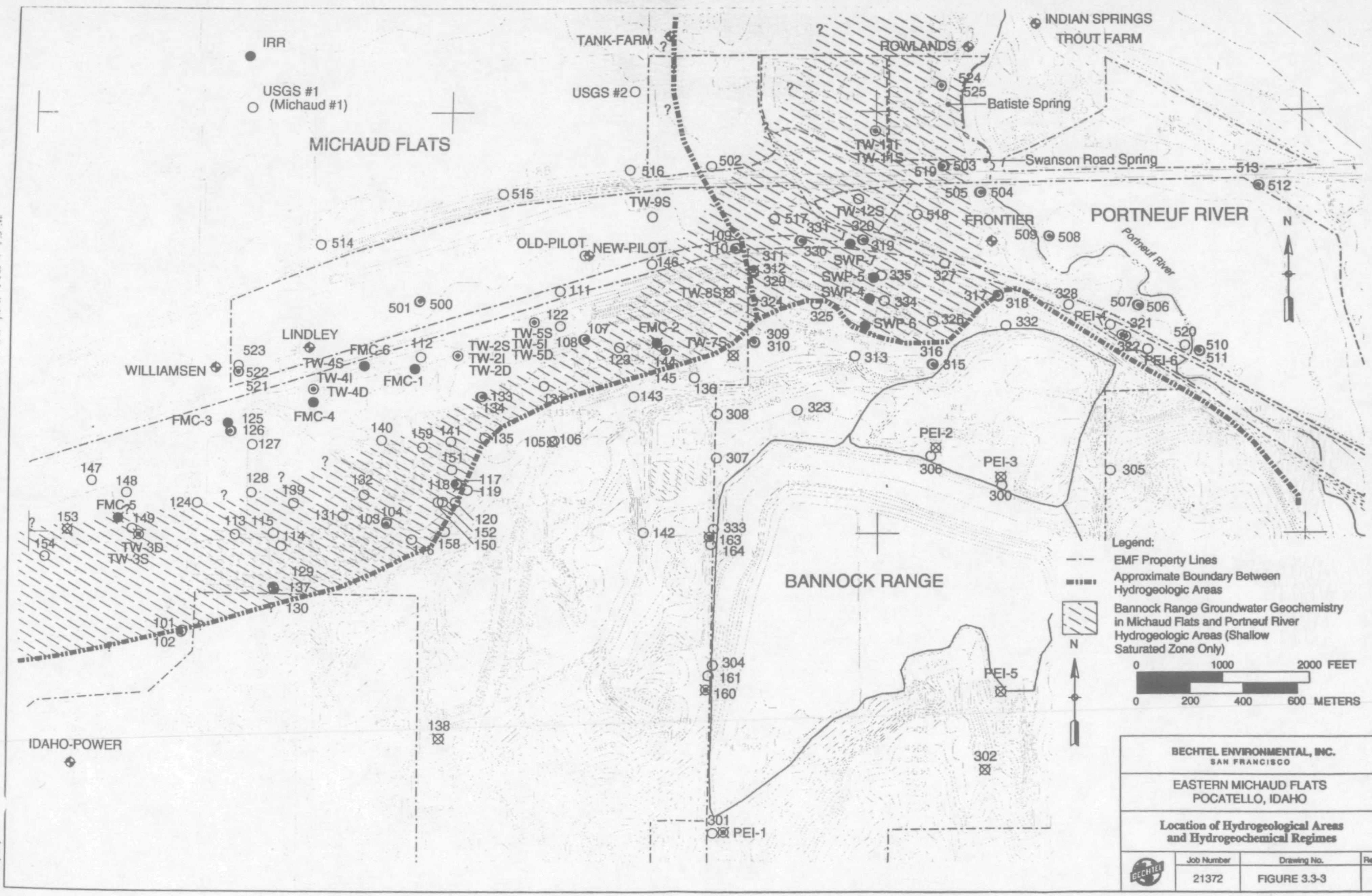
	Deep Wells	Hydraulic Conductivity cm/s	Hydraulic Conductivity ft/day	Type of Test	Source
MICHAUD FLATS	103	5.20E-03	14.7	Slug Test	BEI
	107	2.20E-02	62.4	Slug Test	BEI
	109	5.15E-03	14.6	Slug Test	BEI
	125	7.22E-02	205	Slug Test	Hydrometrics
	133	1.20E-01	340	Slug Test	BEI
	145	2.15E-01	609	Slug Test	BEI
	500	6.70E-02	190	Slug Test	BEI
BANNOCK RANGE	315	1.19E-02	33.7	Slug Test	BEI
PORTNEUF RIVER	311	8.60E-04	2.44	Slug Test	BEI
	317	9.90E-03	28.1	Slug Test	BEI
	319	1.00E-02	28.4	Slug Test	BEI
	321	1.50E-01	425	Slug Test	BEI
	322	2.80E-01	794.7	Pumping Test	BEI
	329	3.65E-01	1030	Slug Test	BEI
	330	5.64E-02	160	Slug Test	Hydrometrics
	504	7.10E-02	201	Slug Test	Hydrometrics
	506	2.30E-01	652	Slug Test	BEI
	512	5.80E-01	1640	Slug Test	BEI
	519	1.59E-02	45.0	Slug Test	Hydrometrics

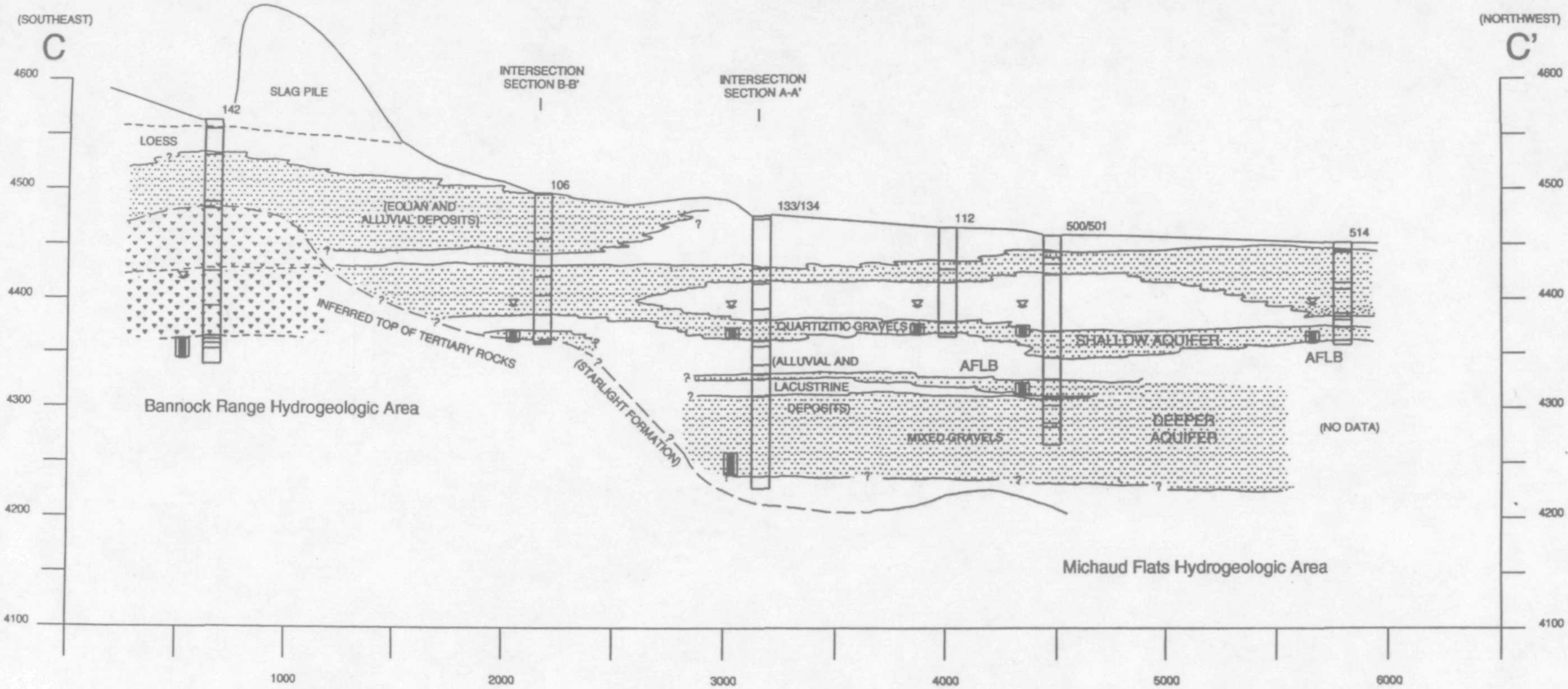
	Production Wells	Transmissivity (ft^2/day)	Transmissivity (gpd/ft)	Type of Test	Source
MICHAUD FLATS	FMC-6	7370	55130	Pumping Test	BEI
	32ACD1	35100	262550	Pumping Test	USGS
	32DDC1	135700	1015000	Pumping Test	USGS
	33BAA1	21900	163810	Pumping Test	USGS
	33CCD1	41400	309670	Pumping Test	USGS
	34ADD1	40400	302190	Pumping Test	USGS
	34DCC1	36600	273770	Pumping Test	USGS
	35DDC1	164400	1229700	Pumping Test	USGS
	3ACD1	41200	308176	Pumping Test	USGS
	3BDC1	444000	3321100	Pumping Test	USGS
	4BBA1	38500	287980	Pumping Test	USGS
	5BDA1	36800	275260	Pumping Test	USGS
	8ADA1	27300	204200	Pumping Test	USGS
	9CAC1	199000	1488500	Pumping Test	USGS
	12BBC1	54700	409160	Pumping Test	USGS
PORTNEUF RIVER	SWP-7	227270	1700000	Pumping Test	Simplot

References
BEI = Bechtel Environmental, Inc., Preliminary Site Characterization Summary for the Eastern Michaud Flats site, January, 1994
PEI = PEI Associates, Inc., Evaluation of Waste Management for Phosphate Processing, April 1985
Hydrometrics = Hydrometrics, Inc., Hydraulic Conductivity Testing of Existing Well Sites at the Eastern Michaud Flats Site, Pocatello, Idaho, April 1994
USGS = United States Geological Survey, Water-Resources Investigations Report 84-4201, Hydrogeology of Eastern Michaud Flats, Fort Hall Indian Reservation, Idaho
Simplot = J.R. Simplot files
FMC = FMC files

Hydraulic conductivity at Well 318 not used in K-zone mapping due to potential precipitation reactions in formation related to mixing of low pH water with groundwater.
Transmissivity at Well 311 not used due to possible grout contamination in filter pack.

Surface and Subsurface Characterizations
Figures for Section 3.3


MICHAUD FLATS
PORTNEUF RIVER
BANNOCK RANGE
Portneuf River
INDIAN SPRINGS
TROUT FARM
ROWLANDS
TANK-FARM
IRR
USGS #1
(Michaud #1)
USGS #2
Batiste Spring
Swanson Road Spring
FRONTIER
OLD-PILOT
NEW-PILOT
LINDLEY
WILLIAMSEN
IDAHO-POWER
Legend:
EMF Property Lines
Approximate Boundary Between Hydrogeologic Areas
Bannock Range Groundwater Geochemistry in Michaud Flats and Portneuf River Hydrogeologic Areas (Shallow Saturated Zone Only)
0 1000 2000 FEET
0 200 400 600 METERS
N
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Location of Hydrogeological Areas and Hydrogeochemical Regimes
Job Number
21372
Drawing No.
FIGURE 3.3-3
Rev.



Notes:

1) Ground surface line generalized.

2) Vertical exaggeration = 5x

3) Cross-section is generalized. See boring logs in Appendix for further details.

4) Cross-section lines are shown in Figure 3.1-5.

5) AFLB = American Falls Lake Beds

Legend:

Water level

Well screen

SAND
GRAVELLY SAND
SILTY SAND
CLAYEY SAND
SANDSTONE
GRAVEL
SAND AND GRAVEL
SILTY, SANDY GRAVEL
SILTY GRAVEL
CLAYEY GRAVEL

SILT
CLAYEY SILT
SANDY SILT
GRAVELLY SILT

CLAY
SILTY CLAY
SANDY CLAY
GRAVELLY CLAY

BASALT
RHYOLITE
TUFF

CALICHE
PEAT

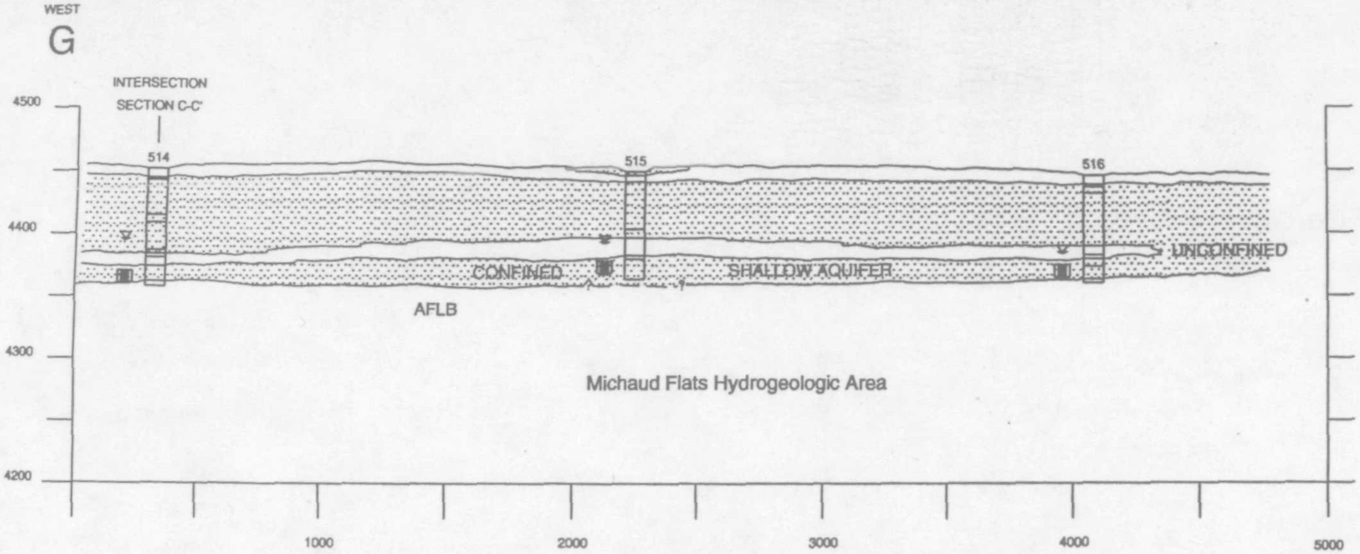
ASPHALT
CONCRETE
FILL

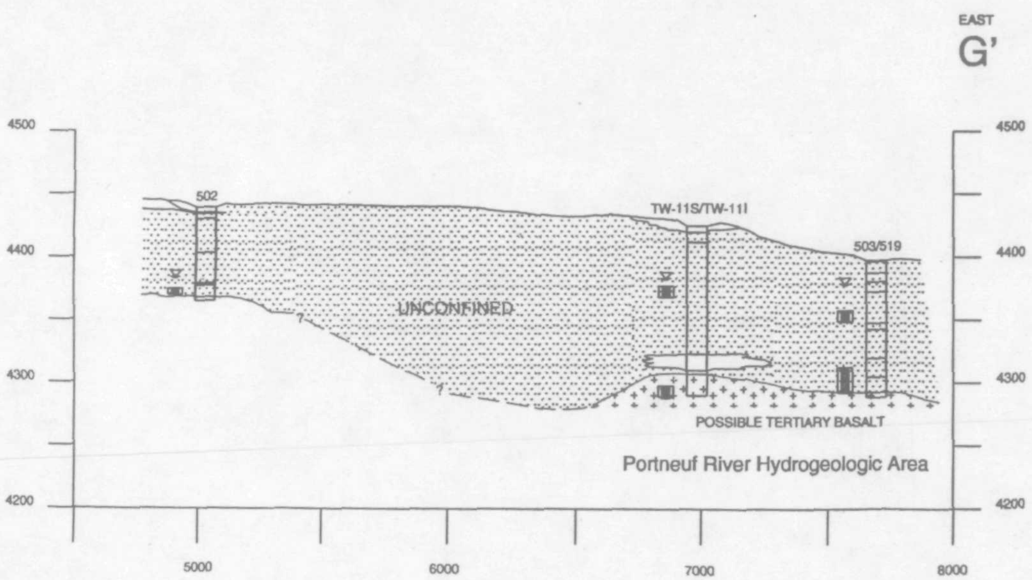
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeologic Cross-Section C-C'

Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-4	





Notes:

1) Ground surface line is generalized.
2) Vertical exaggeration = 5x
3) Cross-section is generalized. See boring logs in Appendix for further details.
4) Cross-section lines are shown in Figure 3.1-5.
5) AFLB = American Falls Lake Beds

Legend:

Water Level
Well Screen

SAND
GRAVELLY SAND
SILTY SAND
CLAYEY SAND
SANDSTONE
GRAVEL
SAND AND GRAVEL
SILTY, SANDY GRAVEL
SILTY GRAVEL
CLAYEY GRAVEL

SILT
CLAYEY SILT
SANDY SILT
GRAVELLY SILT

CLAY
SILTY CLAY
SANDY CLAY
GRAVELLY CLAY

BASALT
RHYOLITE
TUFF

CALICHE
PEAT

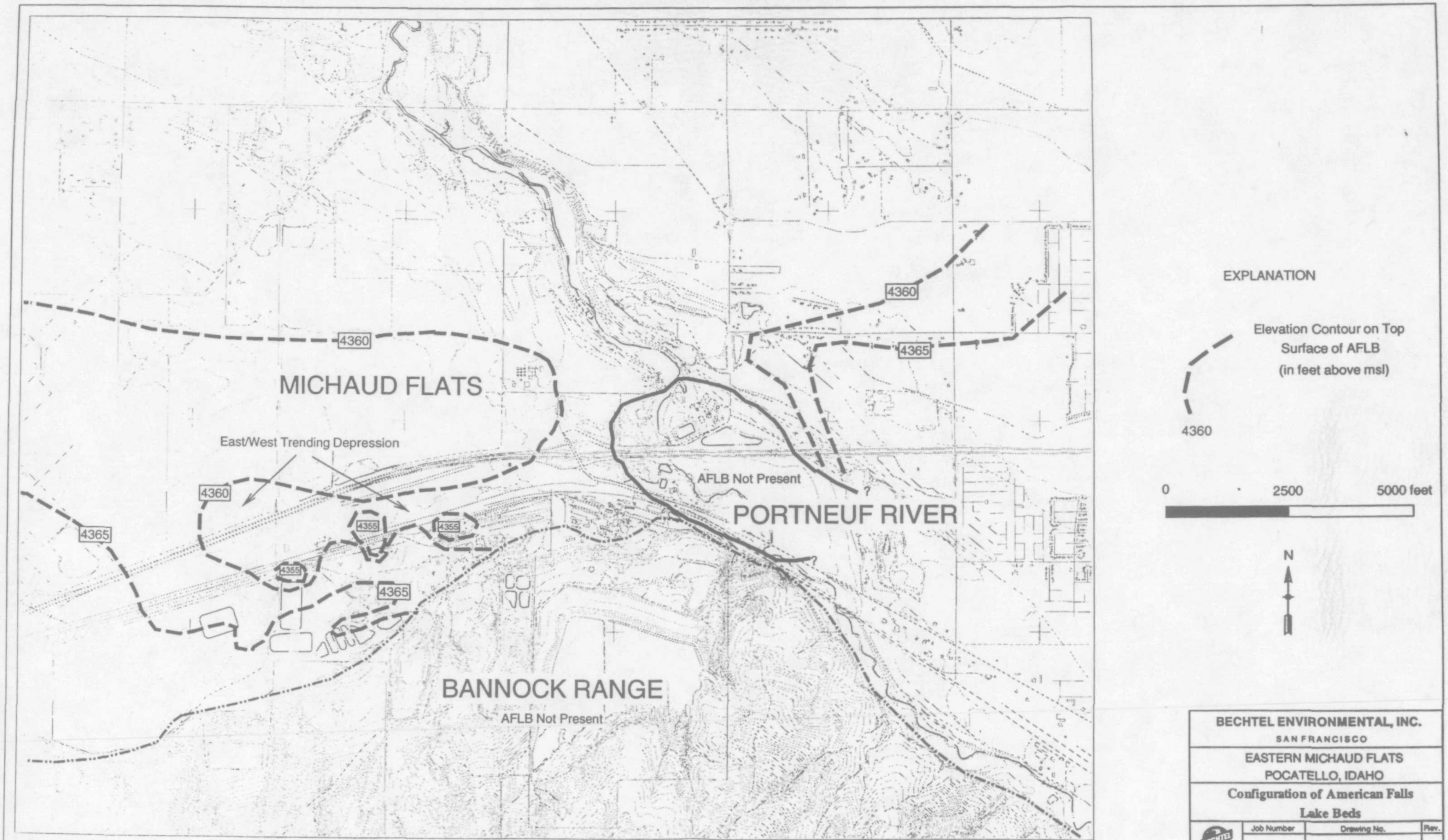
ASPHALT
CONCRETE
FILL

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeologic Cross-Section G-G'

Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-5	

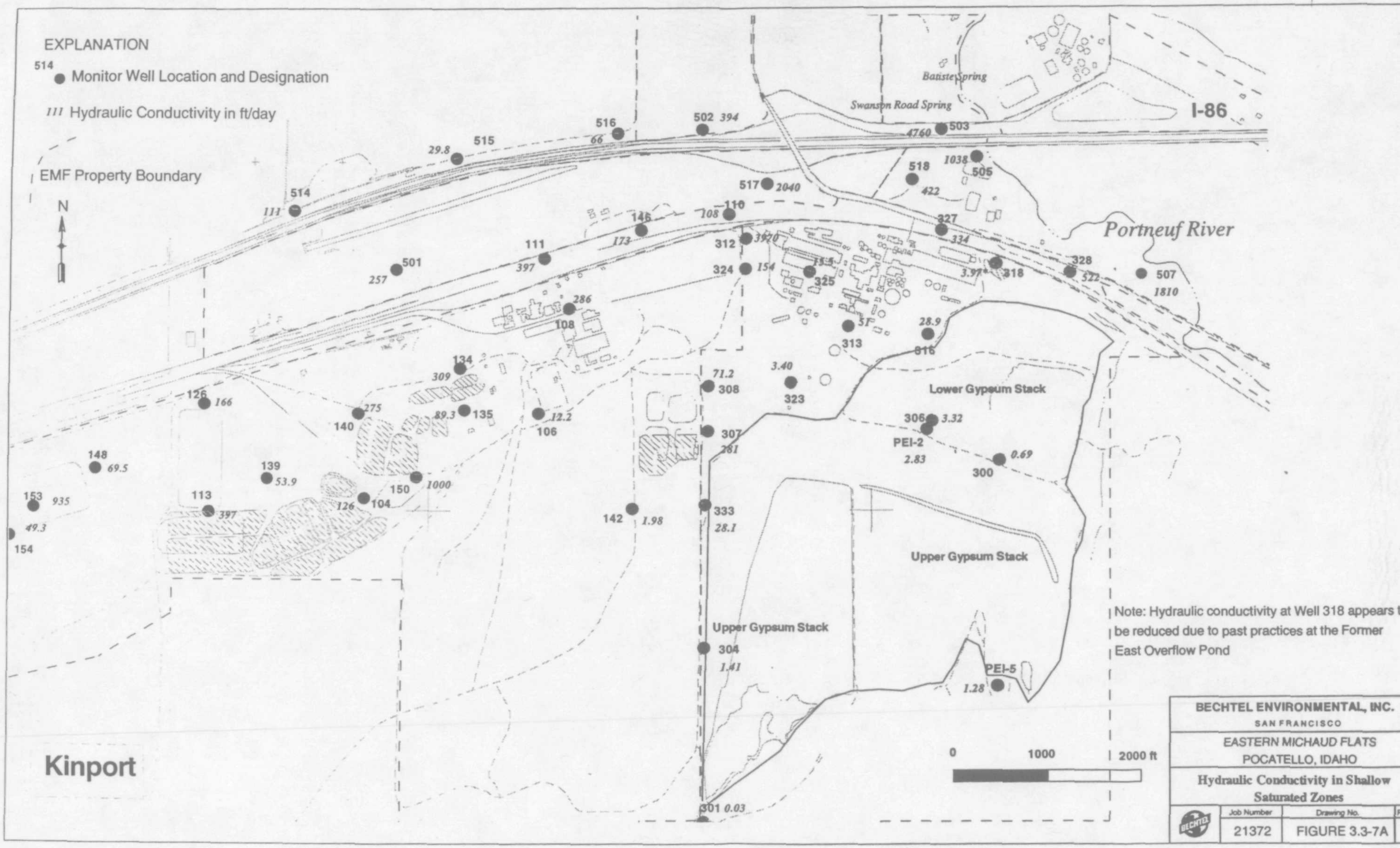


BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

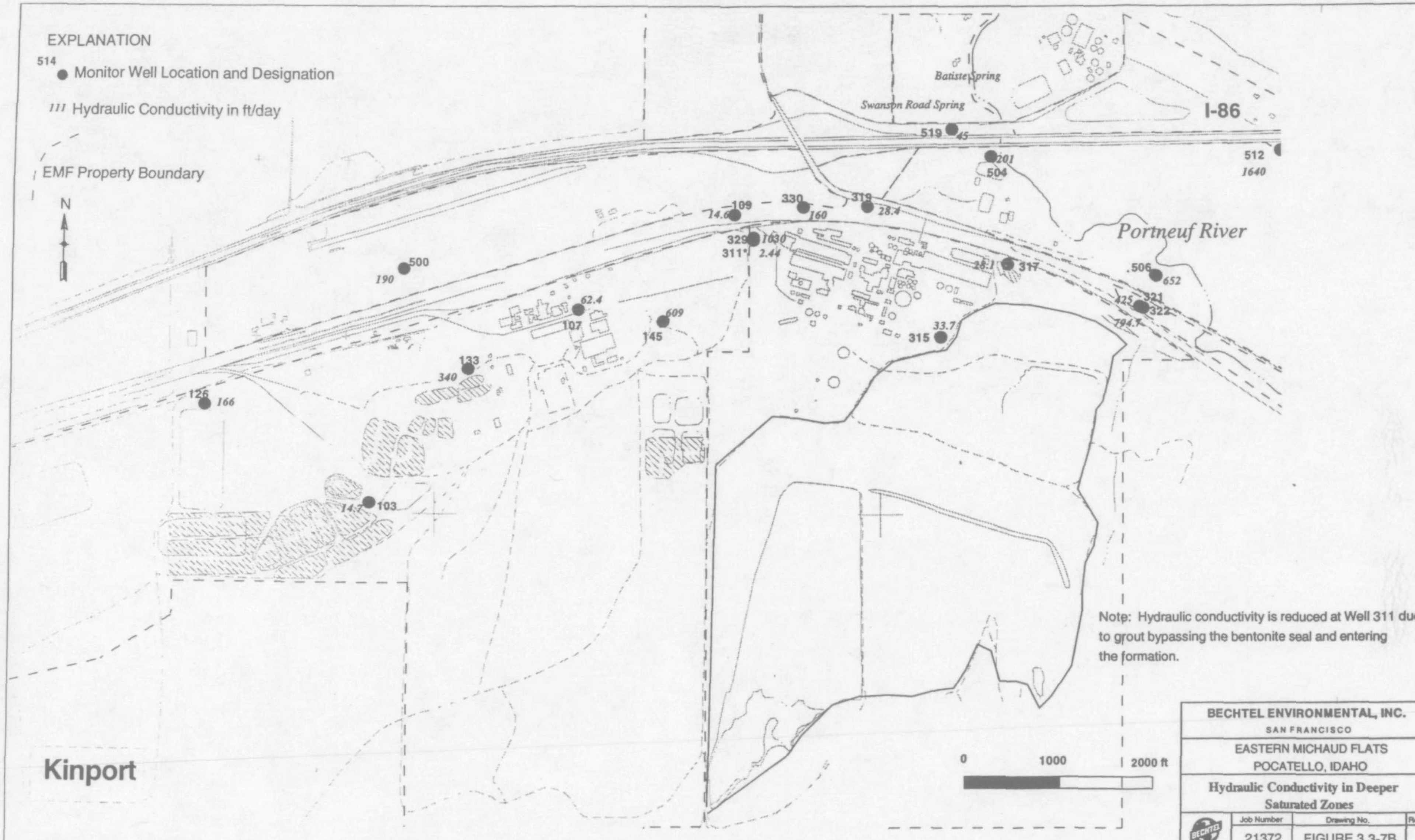
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Configuration of American Falls Lake Beds

Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-6	



BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO	
EASTERN MICHAUD FLATS POCATELLO, IDAHO	
Hydraulic Conductivity in Shallow Saturated Zones	
Job Number	Drawing No.
21372	FIGURE 3.3-7A

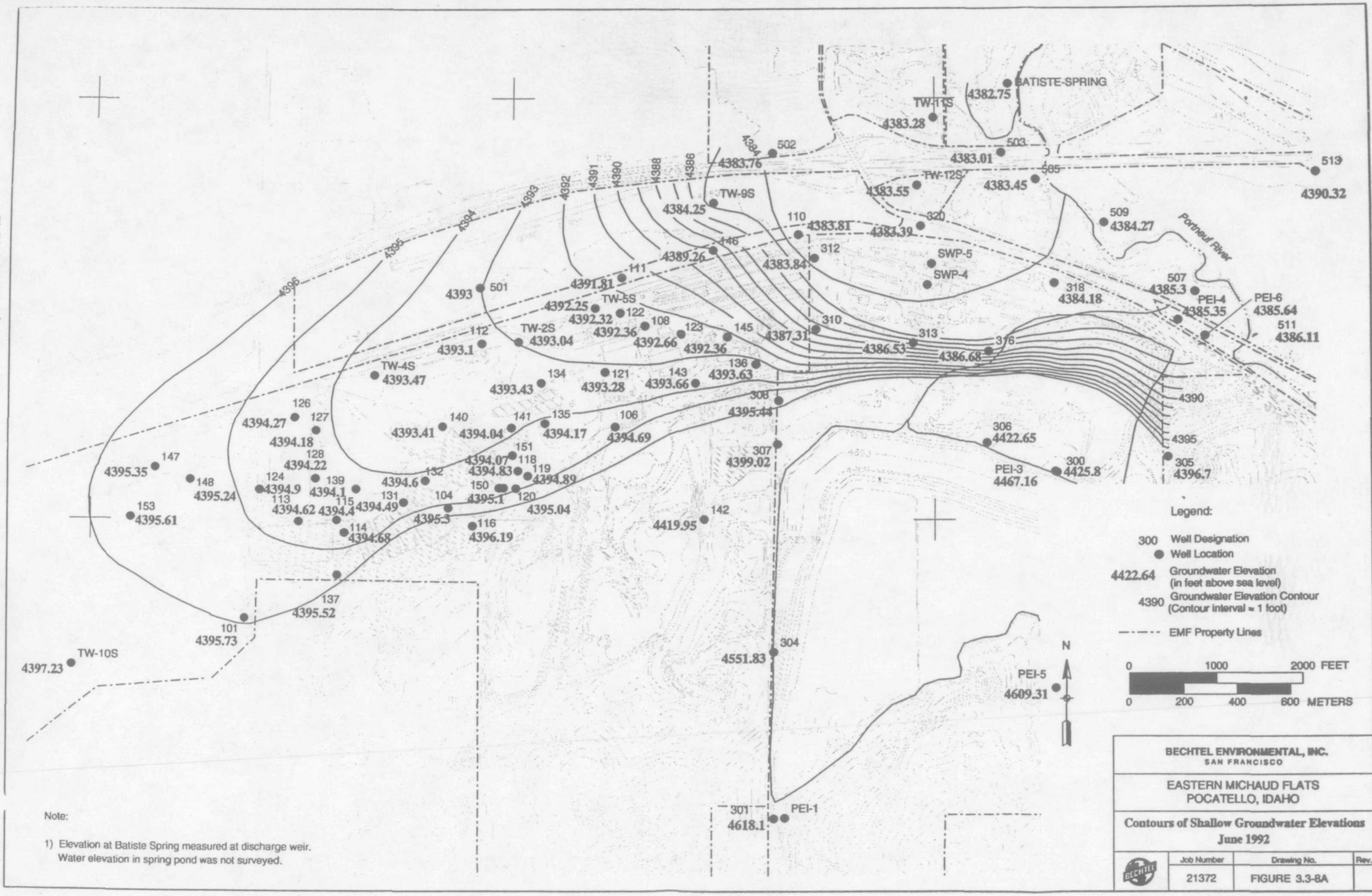


BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

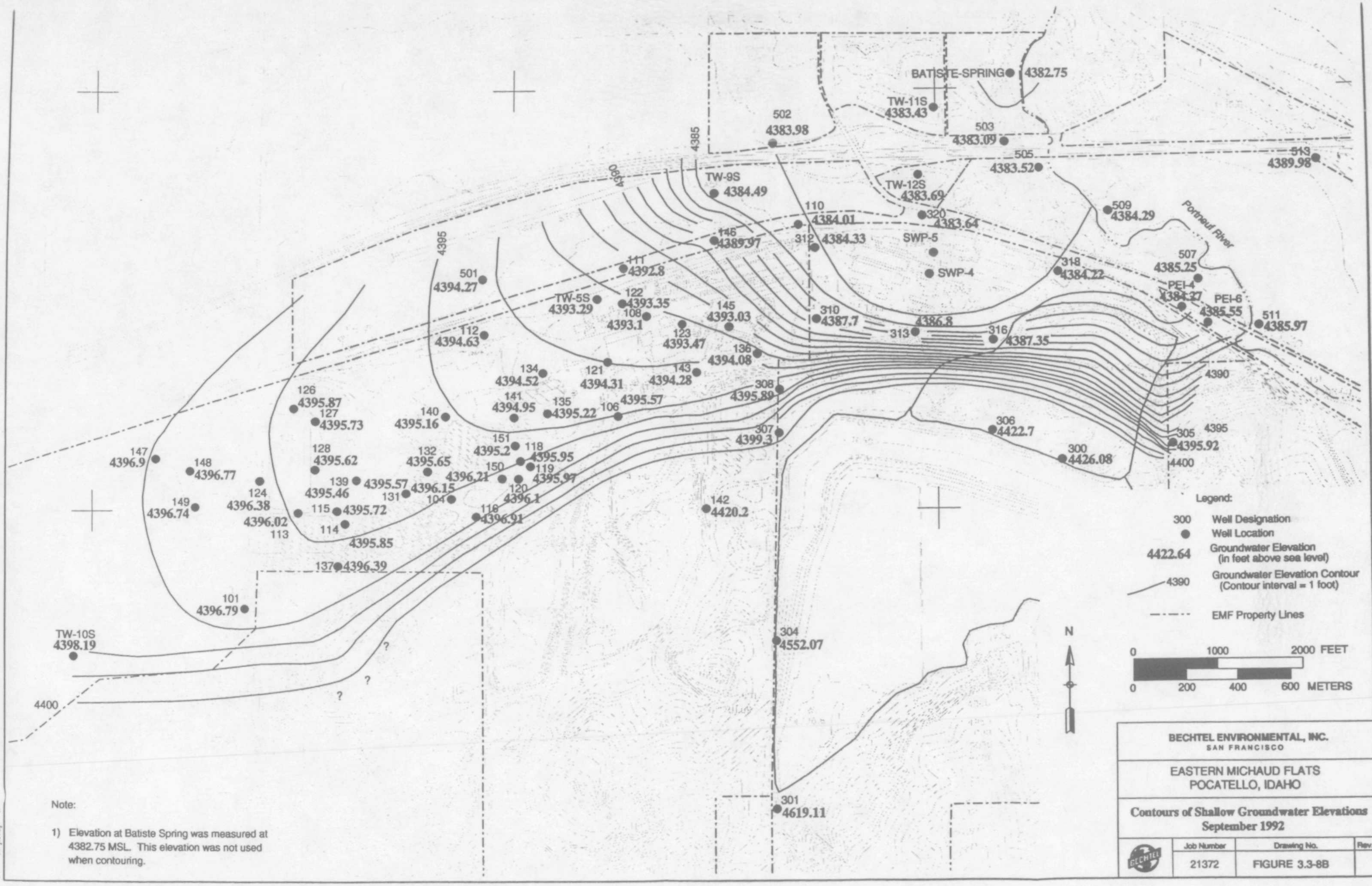
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydraulic Conductivity in Deeper Saturated Zones

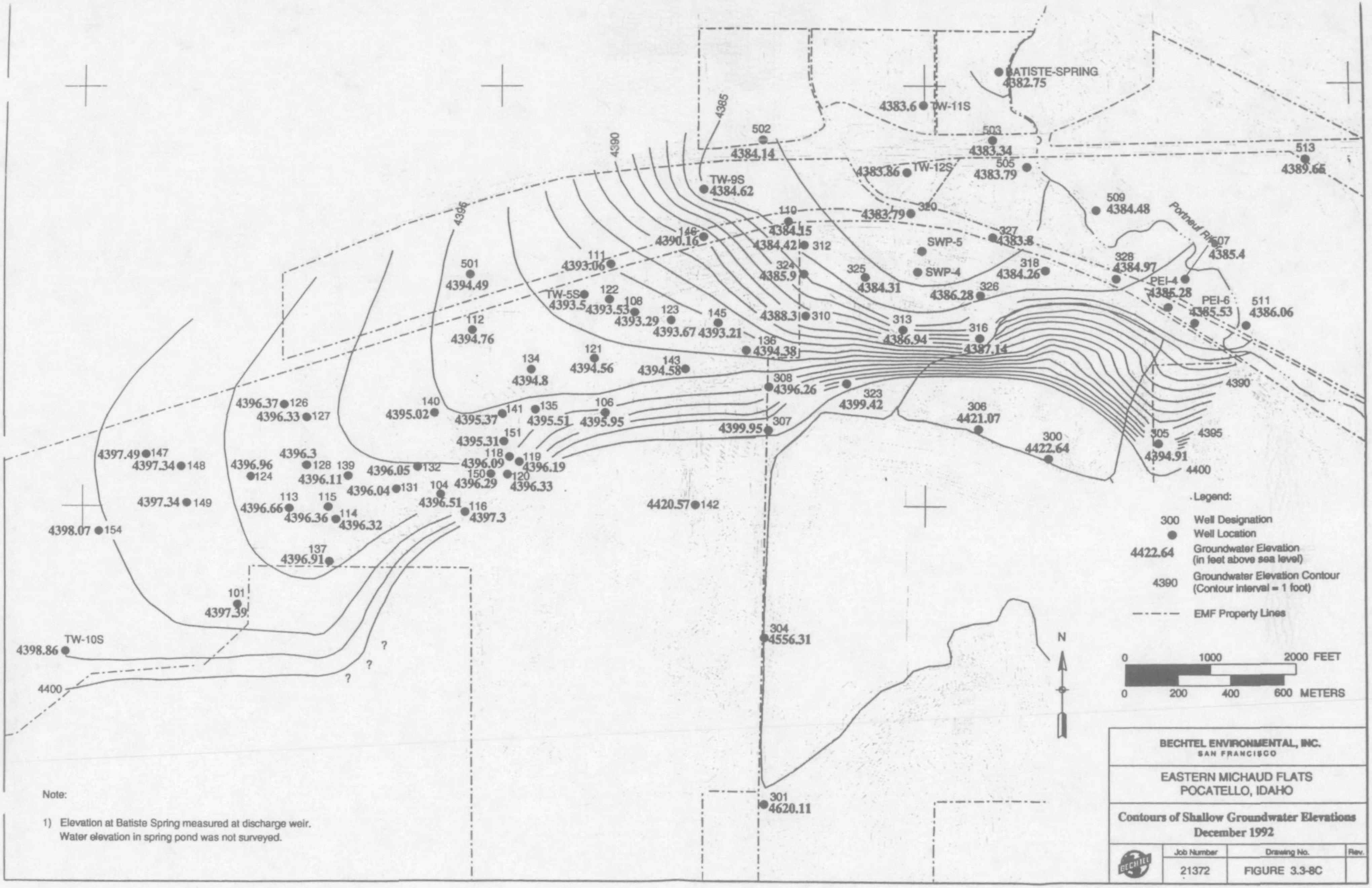
Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-7B	



Contours of Shallow Groundwater Elevations
June 1992



BATISTE-SPRING 4382.75
TW-11S 4383.43
502 4383.98
503 4383.09
505 4383.52
513 4389.98
TW-9S 4384.49
TW-12S 4383.69
110 4384.01
320 4383.64
509 4384.29
Portneuf River
146 4389.97
312 4384.33
SWP-5
SWP-4
111 4392.8
318 4384.22
507 4385.25
PEI-4 4384.37
PEI-6 4385.55
511 4385.97
501 4394.27
TW-5S 4393.29
122 4393.35
108 4393.1
145 4393.03
310 4387.7
313 4386.8
316 4387.35
112 4394.63
123 4393.47
136 4394.08
134 4394.52
121 4394.31
143 4394.28
308 4395.89
126 4395.87
127 4395.73
141 4394.95
135 4395.22
106 4395.57
140 4395.16
307 4399.3
306 4422.7
300 4426.08
305 4395.92
151 4395.2
118 4395.95
147 4396.9
148 4396.77
128 4395.62
132 4395.65
150
119 4395.97
4396.21
139 4395.57
4395.46
124 4396.38
131 4396.15
120 4396.1
104
142 4420.2
149 4396.74
115 4395.72
116 4396.91
4396.02
113
114
4395.85
137 4396.39
101 4396.79
TW-10S 4398.19
304 4552.07
301 4619.11
4385
4390
4395
4400
?
Legend:
300 Well Designation
Well Location
4422.64 Groundwater Elevation (in feet above sea level)
4390 Groundwater Elevation Contour (Contour interval = 1 foot)
EMF Property Lines
N
0 1000 2000 FEET
0 200 400 600 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Contours of Shallow Groundwater Elevations
September 1992
Job Number 21372
Drawing No. FIGURE 3.3-8B
Rev.
Note:
1) Elevation at Batiste Spring was measured at 4382.75 MSL. This elevation was not used when contouring.



Note:

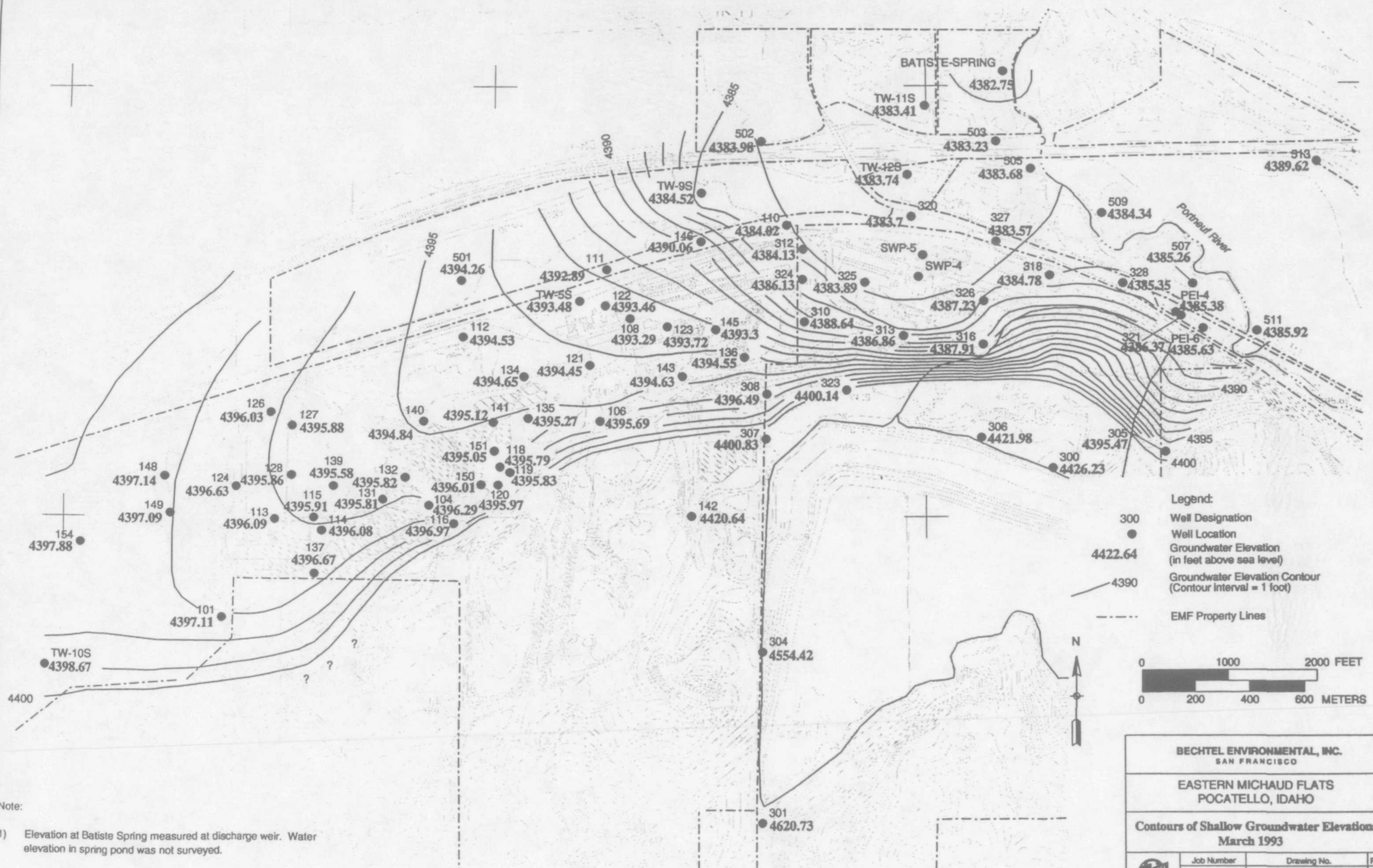
1) Elevation at Batiste Spring measured at discharge weir. Water elevation in spring pond was not surveyed.

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Contours of Shallow Groundwater Elevations
December 1992

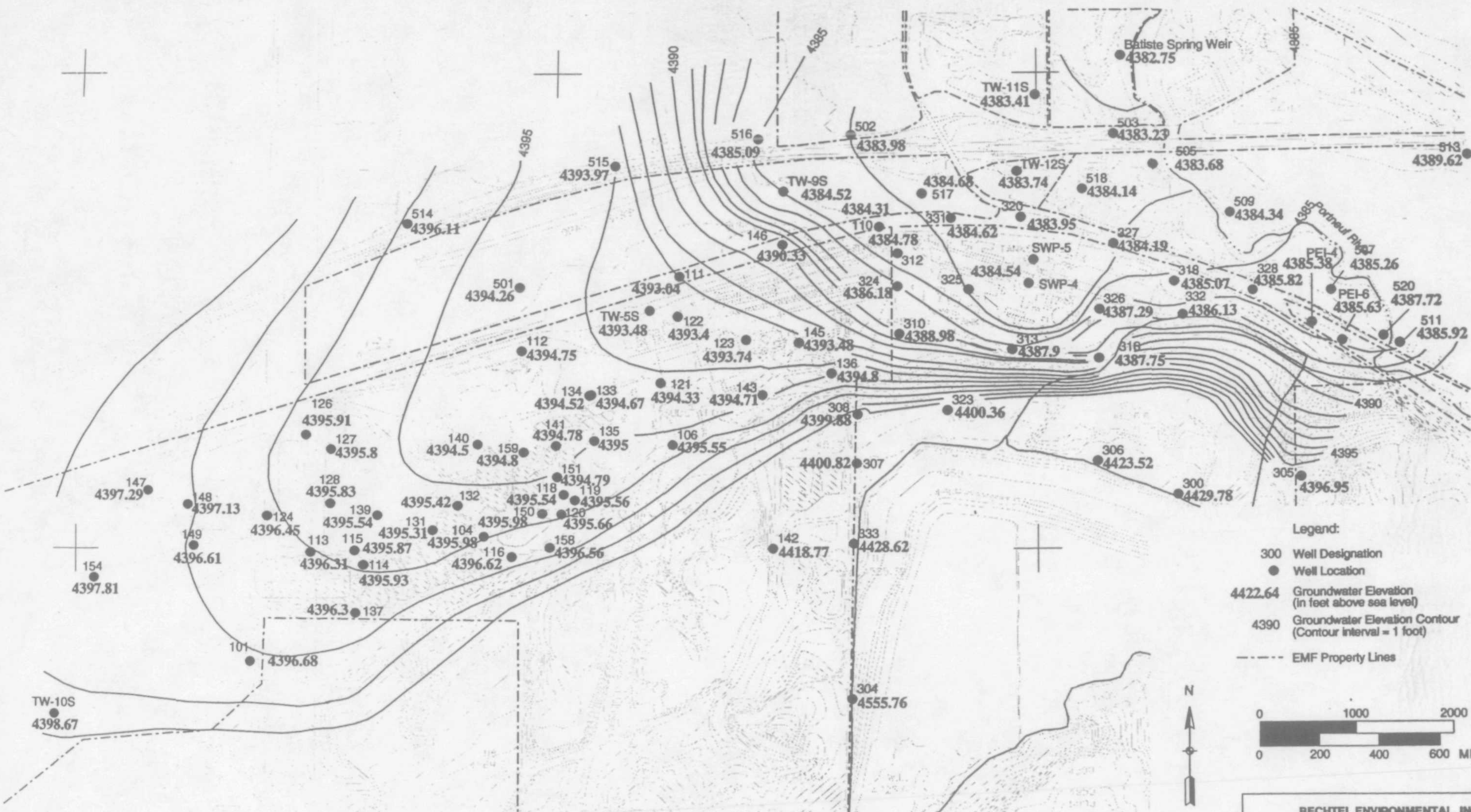
Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-8C	



Note:

1) Elevation at Batiste Spring measured at discharge weir. Water elevation in spring pond was not surveyed.

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Contours of Shallow Groundwater Elevations March 1993		
Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-8D	



Legend:

300 Well Designation

● Well Location

4422.64 Groundwater Elevation (in feet above sea level)

4390 Groundwater Elevation Contour (Contour interval = 1 foot)

- · - · EMF Property Lines

Note:

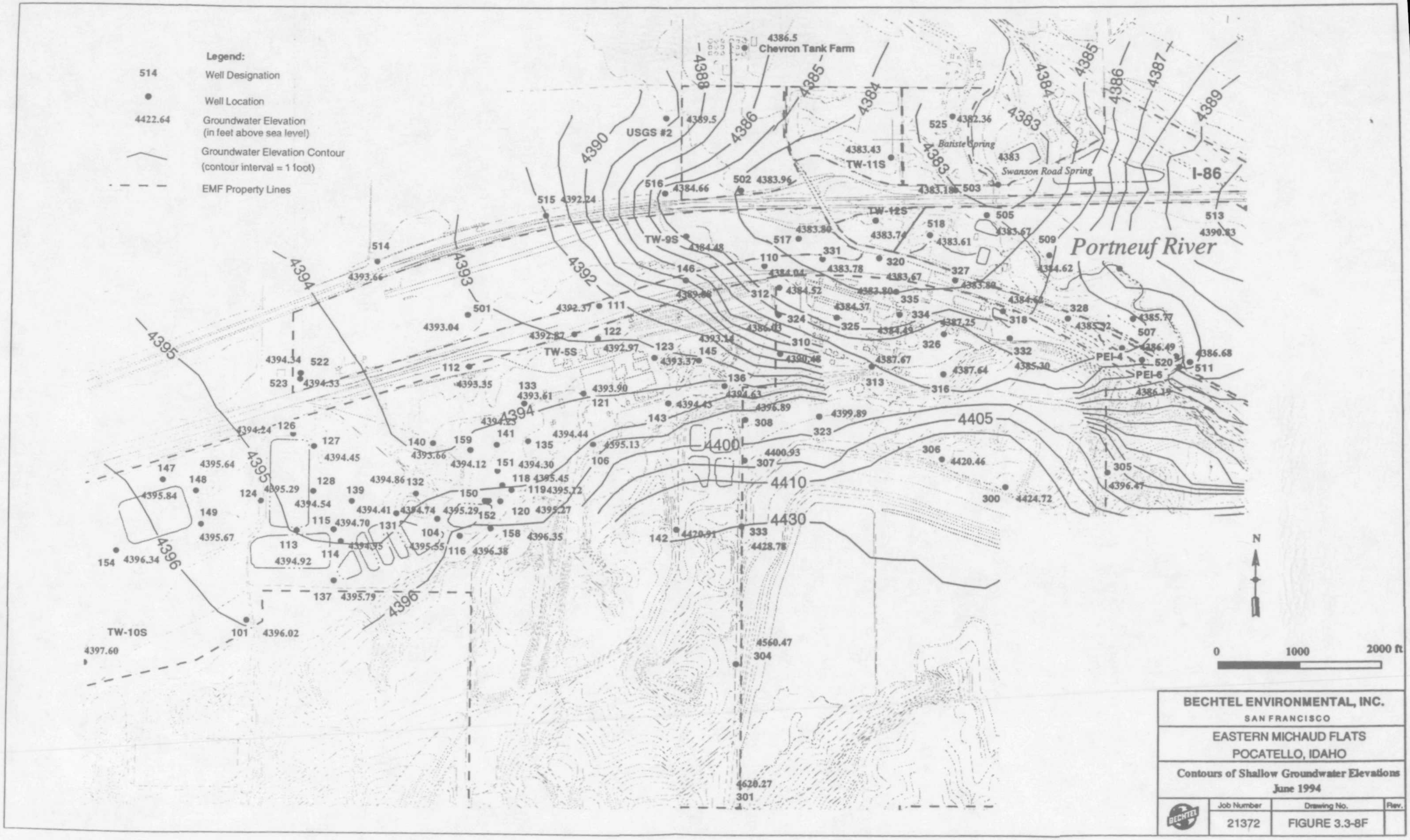
1) Elevation at Batiste Spring measured at discharge weir. Water elevation at spring pond was not surveyed.

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Contours of Shallow Groundwater Elevations
August 1993

Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-8E	

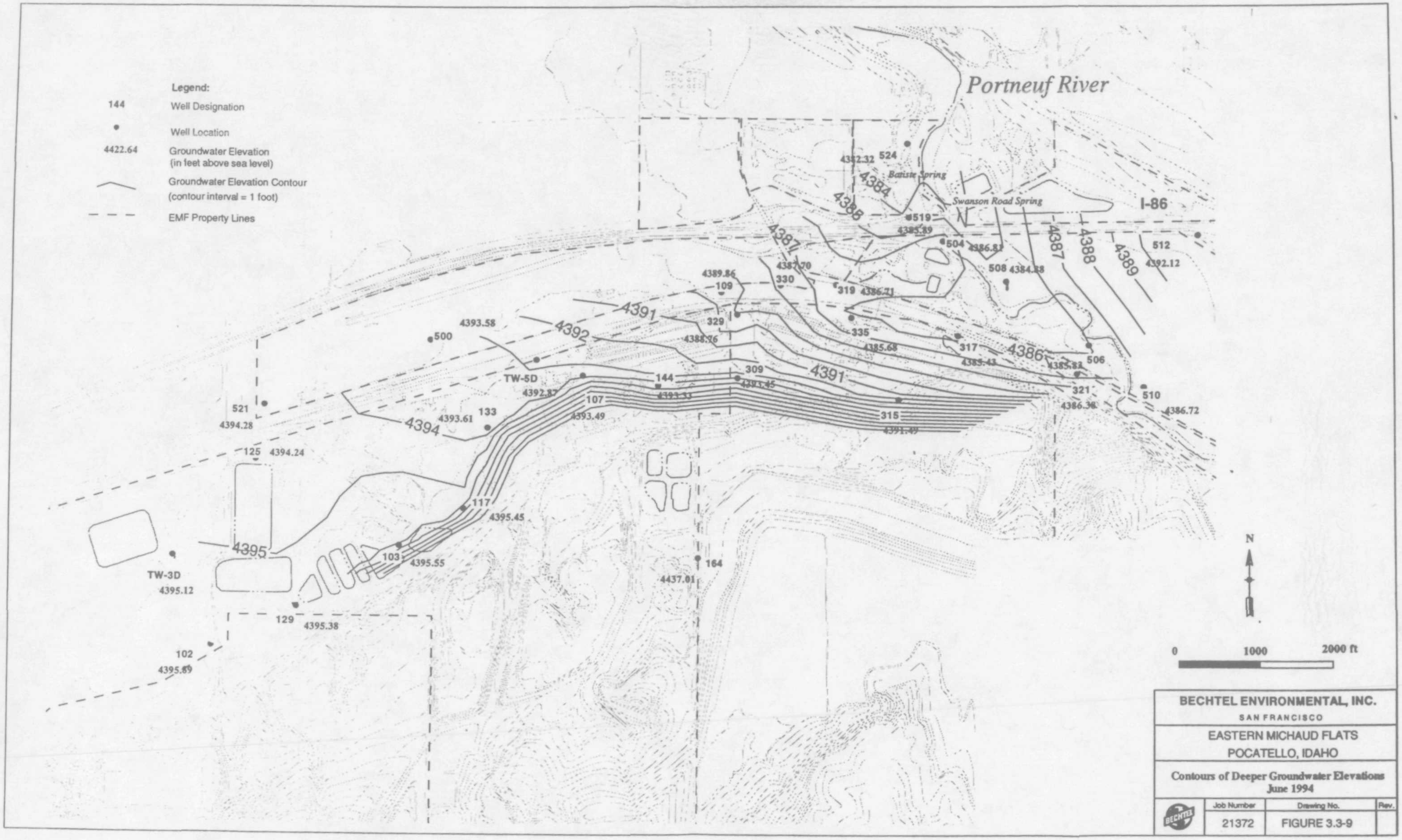


BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Contours of Shallow Groundwater Elevations
June 1994

Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-8F	

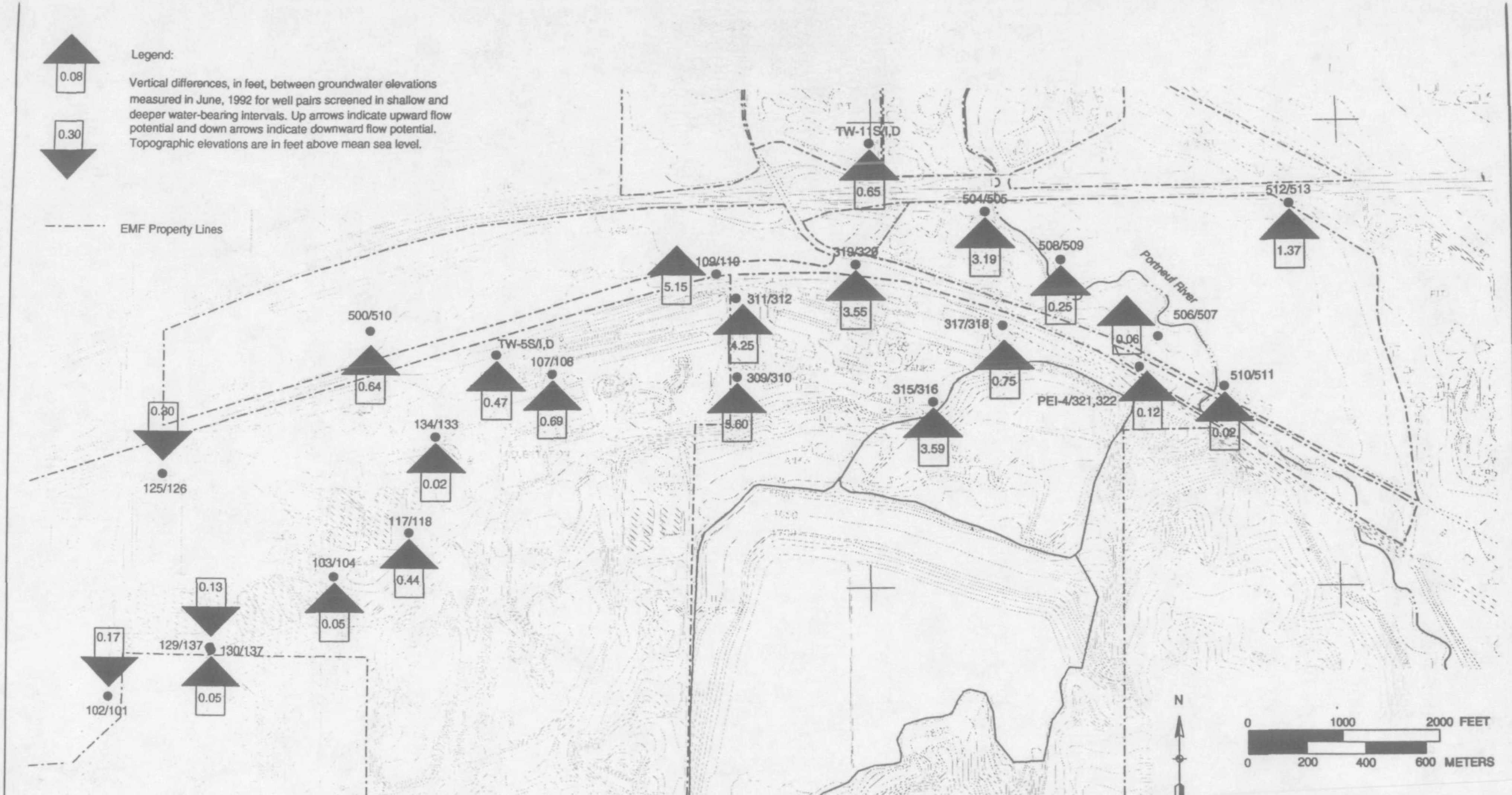


BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Contours of Deeper Groundwater Elevations June 1994

Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-9	

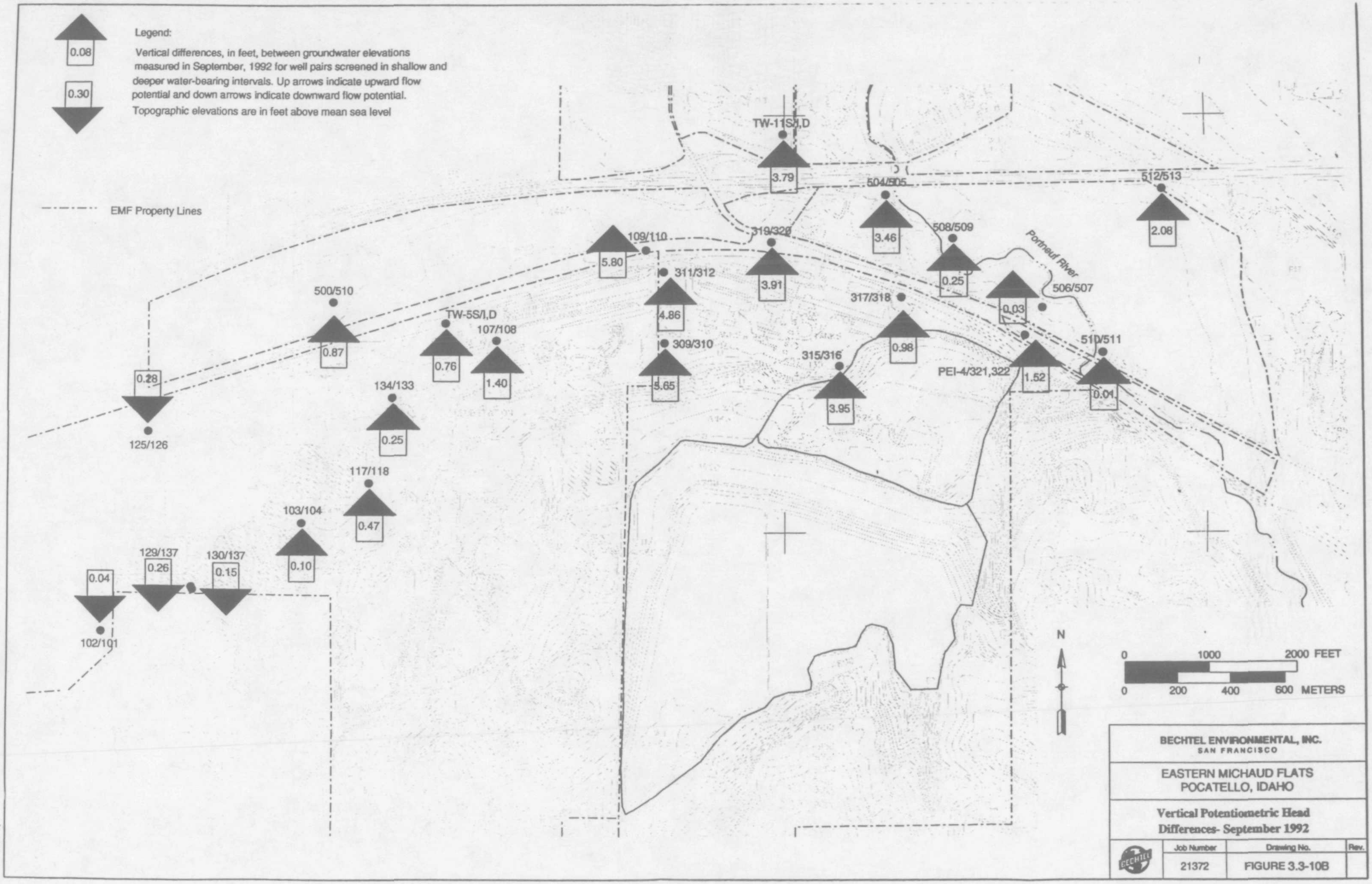


BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Vertical Potentiometric Head Differences-June 1992

Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-10A	

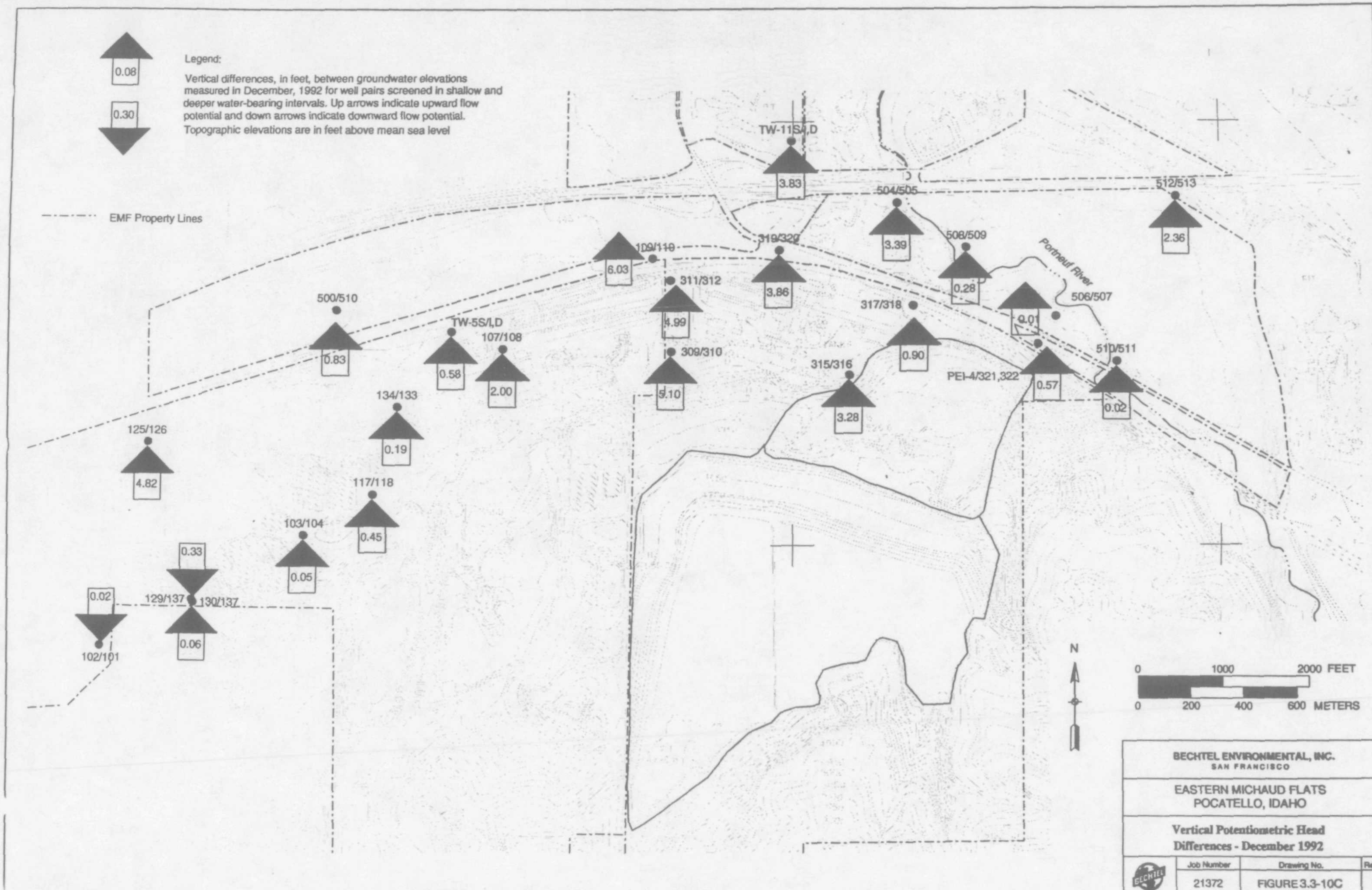


BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Vertical Potentiometric Head Differences- September 1992

Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-10B	

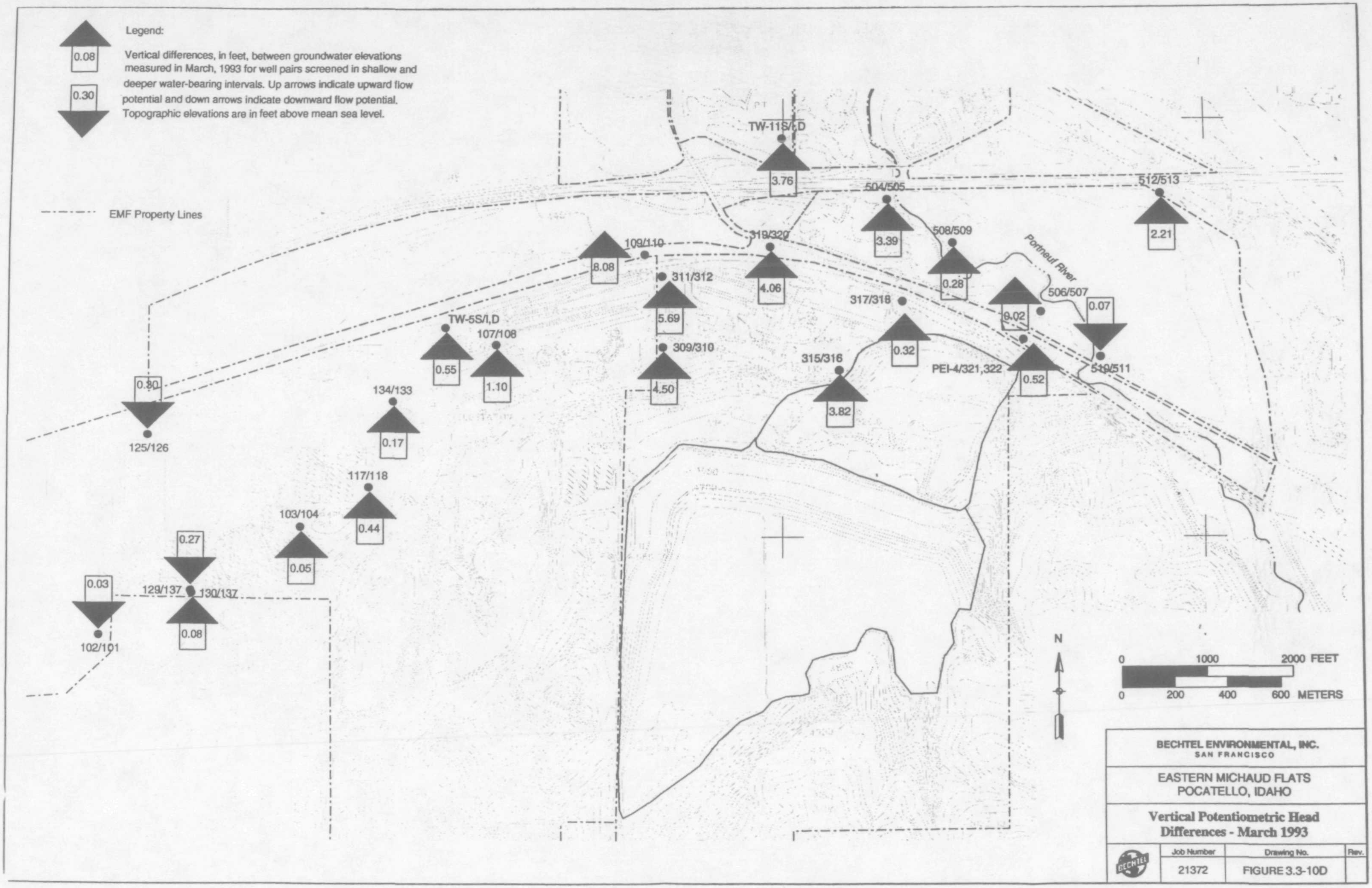


BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Vertical Potentiometric Head Differences - December 1992

Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-10C	



BECHTEL ENVIRONMENTAL, INC.
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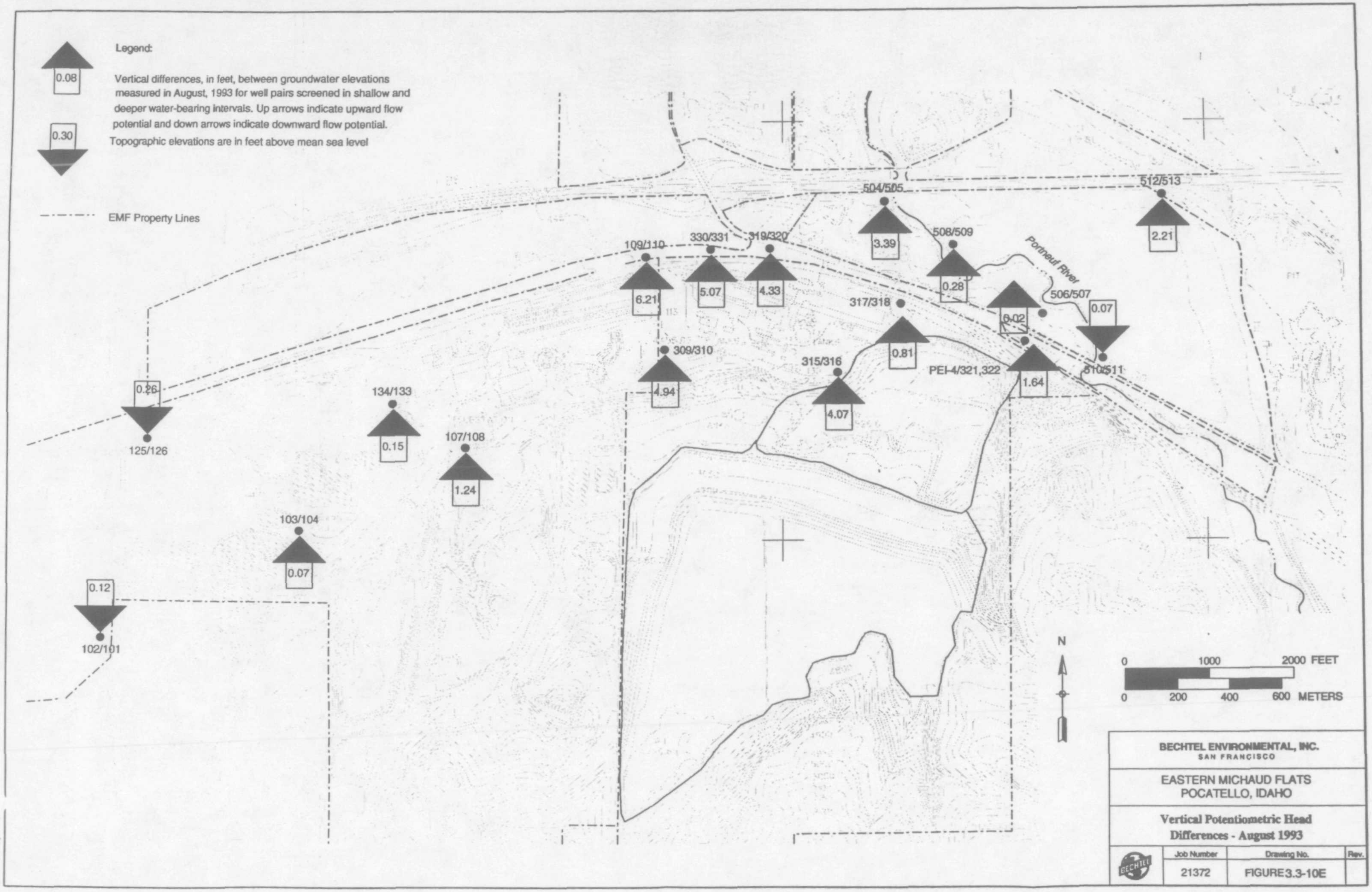
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Vertical Potentiometric Head Differences - March 1993

Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-10D	



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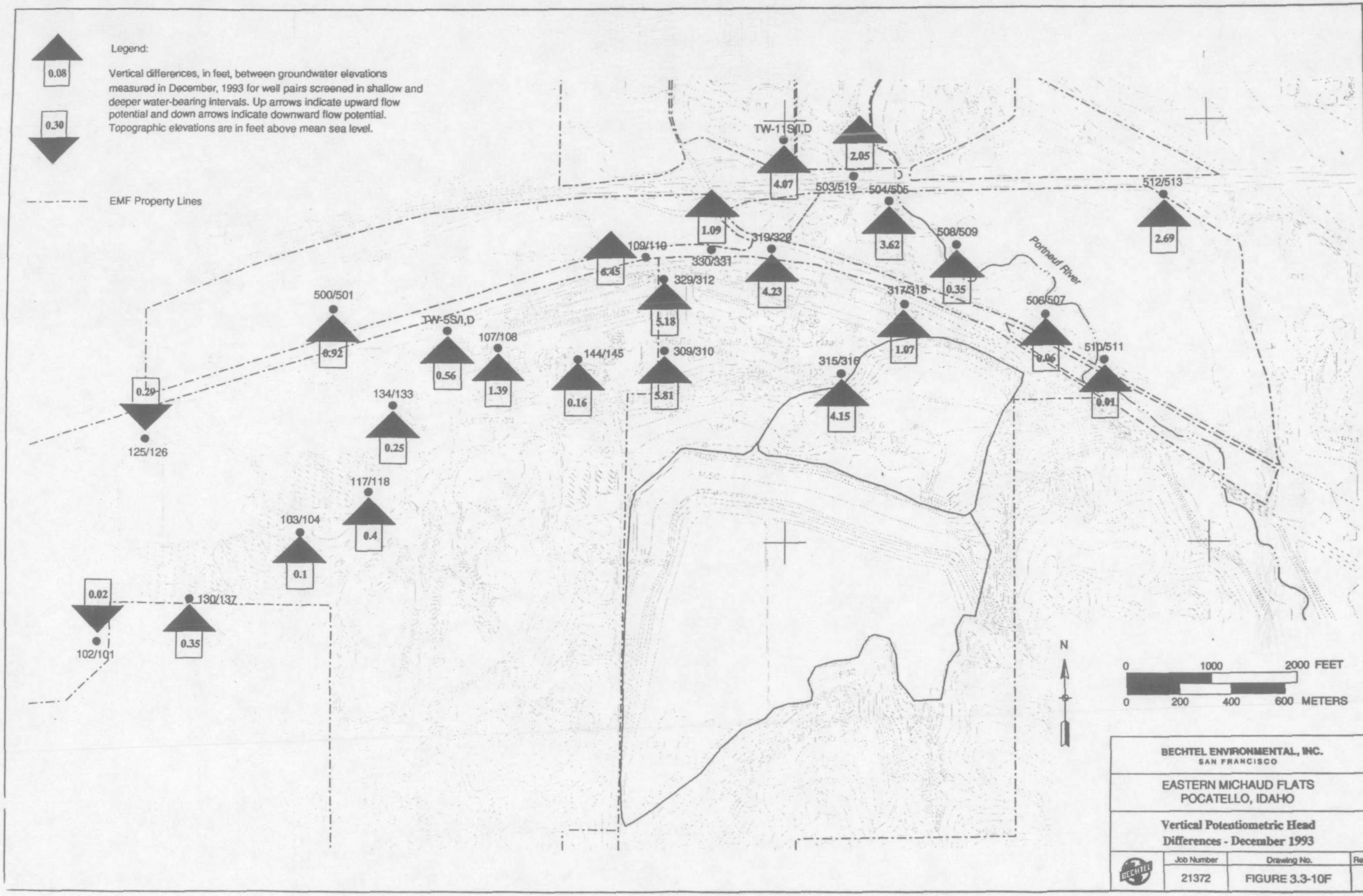
SAN FRANCISCO

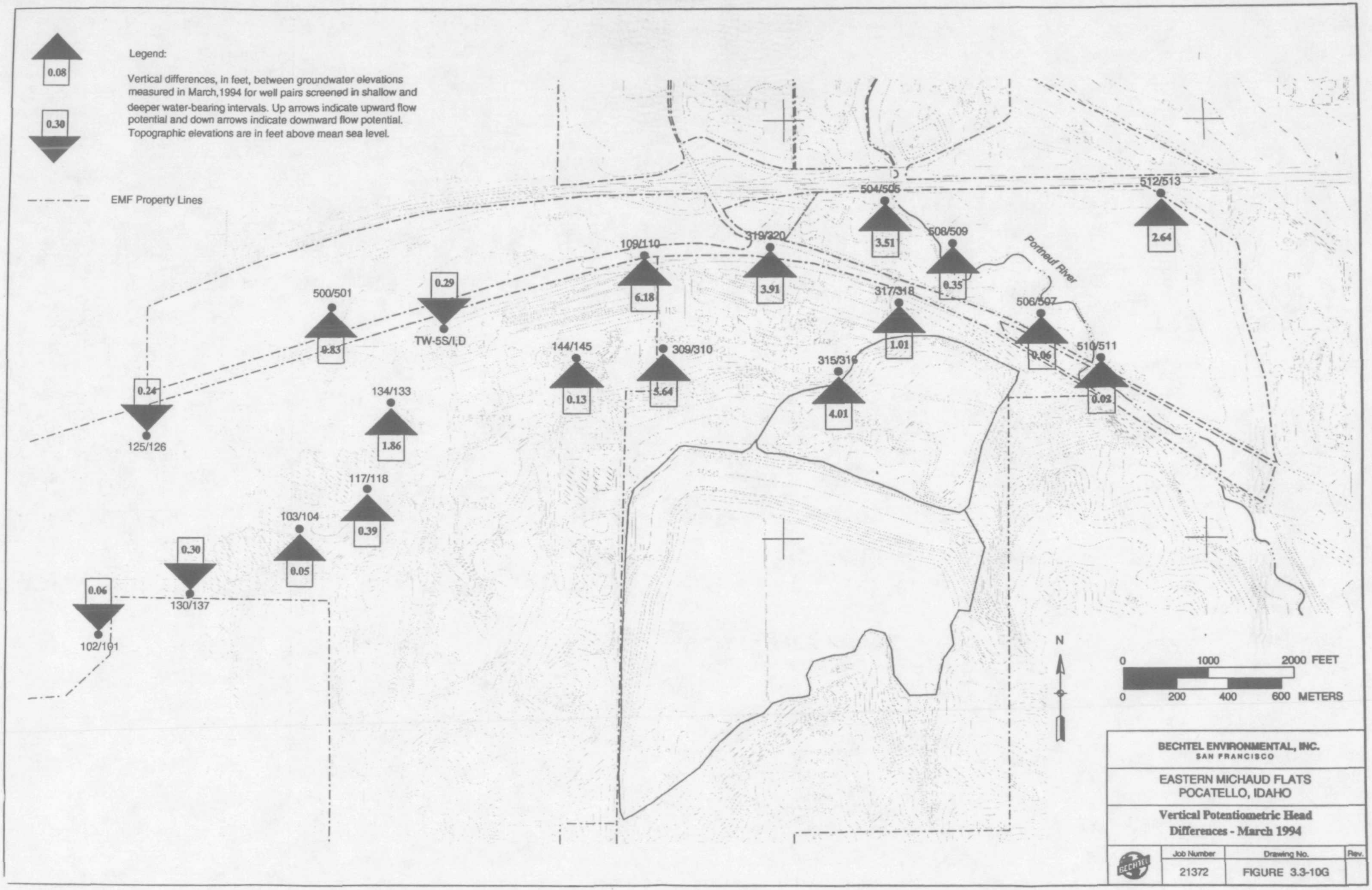
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Vertical Potentiometric Head Differences - August 1993

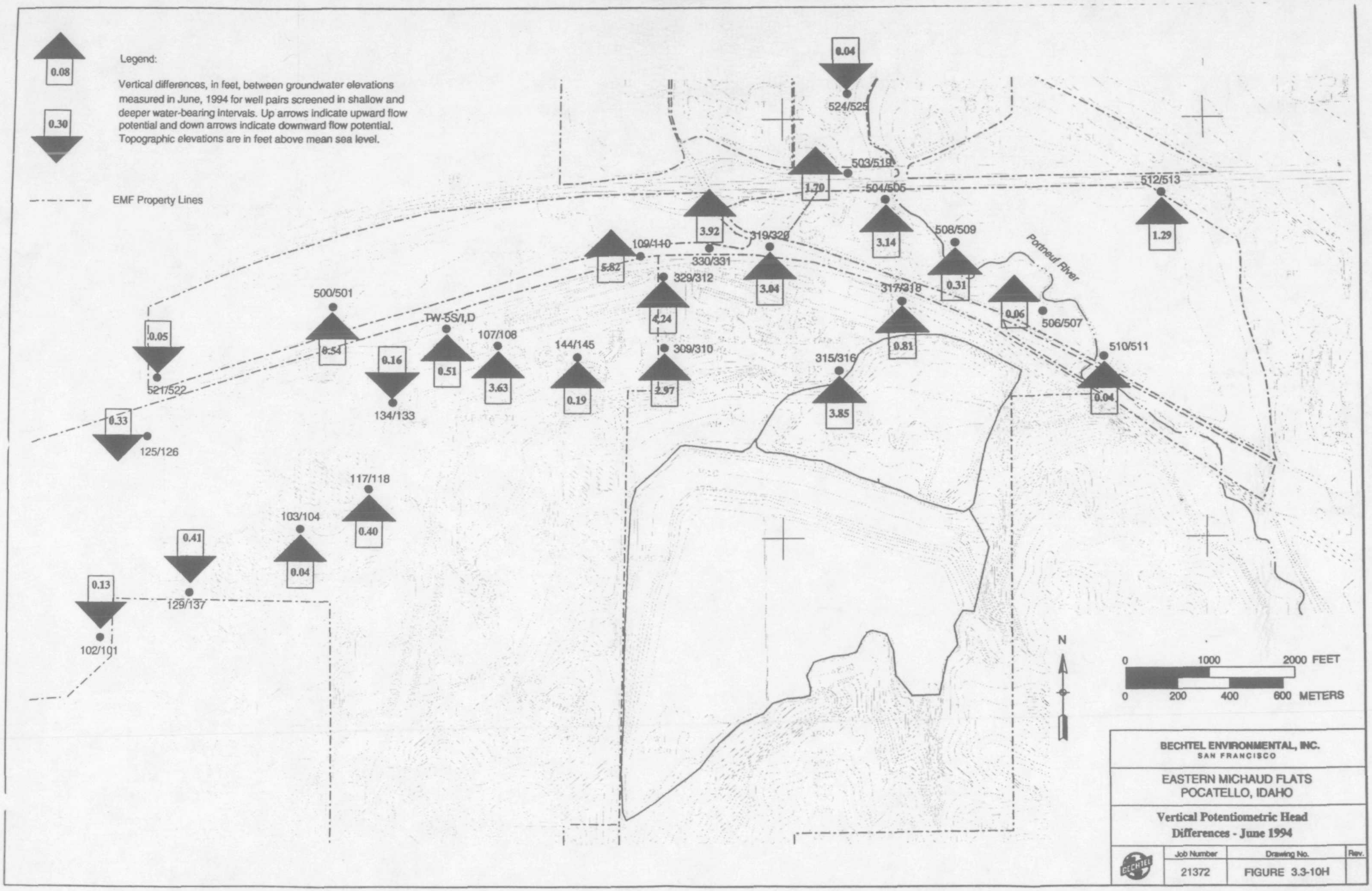
Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-10E	



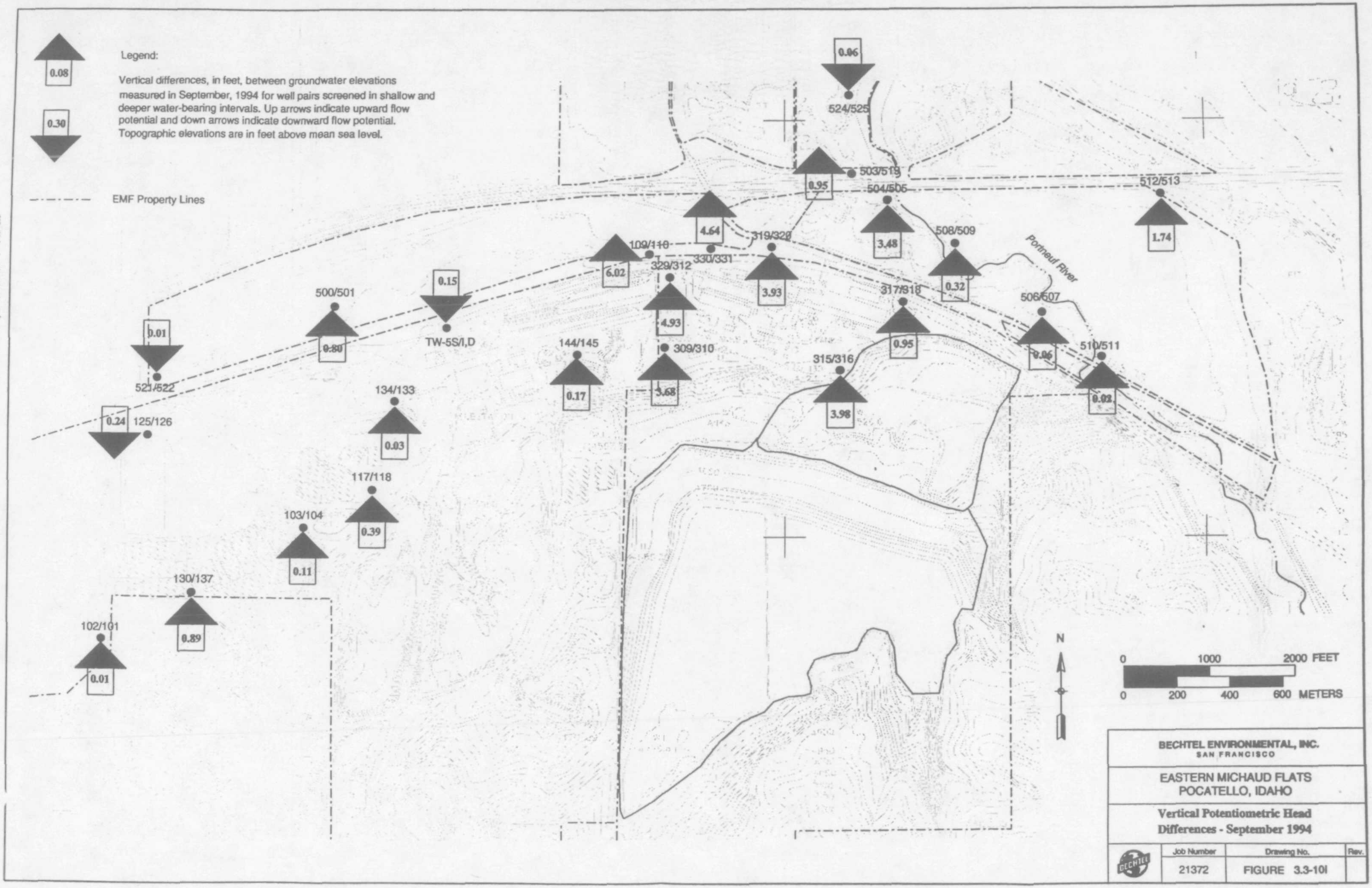
Legend:
0.08
0.30
Vertical differences, in feet, between groundwater elevations measured in December, 1993 for well pairs screened in shallow and deeper water-bearing intervals. Up arrows indicate upward flow potential and down arrows indicate downward flow potential. Topographic elevations are in feet above mean sea level.
EMF Property Lines
TW-11S/I,D
4.07
2.05
503/519
504/505
3.62
512/513
2.69
1.09
330/331
319/320
4.23
508/509
0.35
Portneuf River
109/110
6.45
329/312
5.18
317/318
1.07
506/507
0.06
510/511
0.01
500/501
0.92
TW-5S/I,D
0.56
107/108
1.39
144/145
0.16
309/310
5.81
315/316
4.15
0.29
125/126
134/133
0.25
117/118
0.4
103/104
0.1
0.02
102/101
130/137
0.35
N
0
1000
2000 FEET
0
200
400
600 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Vertical Potentiometric Head Differences - December 1993
Job Number
21372
Drawing No.
FIGURE 3.3-10F
Rev.



Legend:
0.08
0.30
Vertical differences, in feet, between groundwater elevations measured in March,1994 for well pairs screened in shallow and deeper water-bearing intervals. Up arrows indicate upward flow potential and down arrows indicate downward flow potential. Topographic elevations are in feet above mean sea level.
EMF Property Lines
512/513
2.64
504/505
3.51
508/509
0.35
Portneuf River
319/320
3.91
109/110
6.18
317/318
1.01
506/507
0.06
510/511
0.02
500/501
0.83
0.29
TW-5S/I,D
144/145
0.13
309/310
5.64
315/316
4.01
0.24
125/126
134/133
1.86
117/118
0.39
103/104
0.05
0.30
130/137
0.06
102/101
N
0
1000
2000 FEET
0
200
400
600 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Vertical Potentiometric Head Differences - March 1994
Job Number
21372
Drawing No.
FIGURE 3.3-10G
Rev.



Legend:
Vertical differences, in feet, between groundwater elevations measured in June, 1994 for well pairs screened in shallow and deeper water-bearing intervals. Up arrows indicate upward flow potential and down arrows indicate downward flow potential. Topographic elevations are in feet above mean sea level.
0.08
0.30
EMF Property Lines
0.04
524/525
503/519
1.70
504/505
3.14
512/513
1.29
3.92
109/110
330/331
5.82
319/320
3.04
329/312
4.24
508/509
0.31
Portneuf River
317/318
0.81
0.06
506/507
500/501
0.54
TW-5S/I,D
0.51
107/108
3.63
144/145
0.19
309/310
2.97
315/316
3.85
510/511
0.04
0.05
521/522
0.16
134/133
0.33
125/126
117/118
0.40
103/104
0.04
0.41
129/137
0.13
102/101
N
0
1000
2000 FEET
0
200
400
600 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Vertical Potentiometric Head Differences - June 1994
Job Number
21372
Drawing No.
FIGURE 3.3-10H
Rev.



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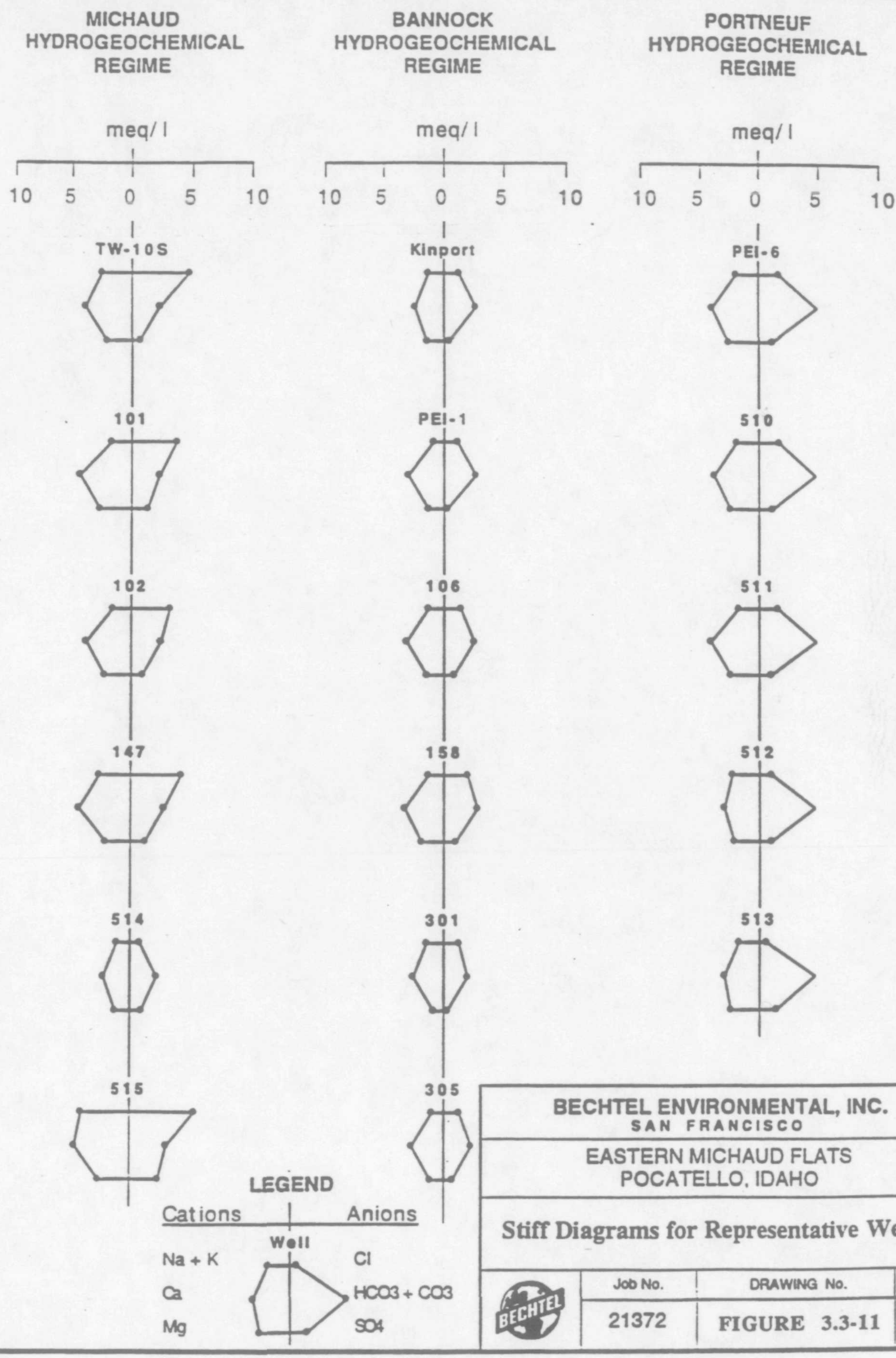
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Vertical Potentiometric Head Differences - September 1994

Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-10I	



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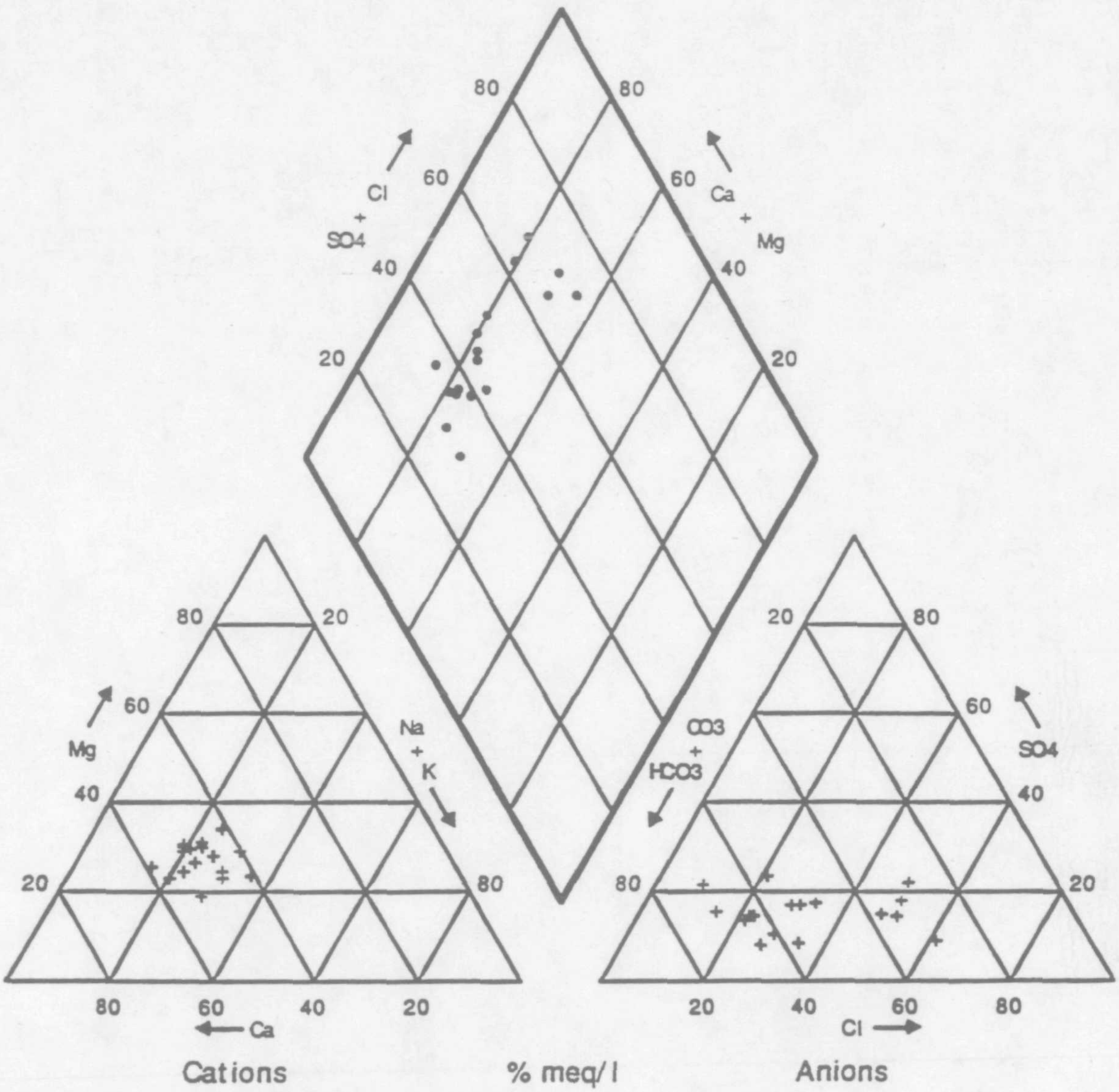
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Stiff Diagrams for Representative Wells

Job No.	DRAWING No.	REV.
21372	FIGURE 3.3-11	



No	TDS	Sample Site
M1	512	TW-10S
M2	498	101
M3	448	102
M4	553	147
M5	290	514
M6	713	515
B1	329	Kinport
B2	309	PEI-1
B3	349	106
B4	403	158
B5	271	301
B6	310	305
P1	566	PEI-6
P2	549	510
P3	551	511
P4	509	512
P5	505	513

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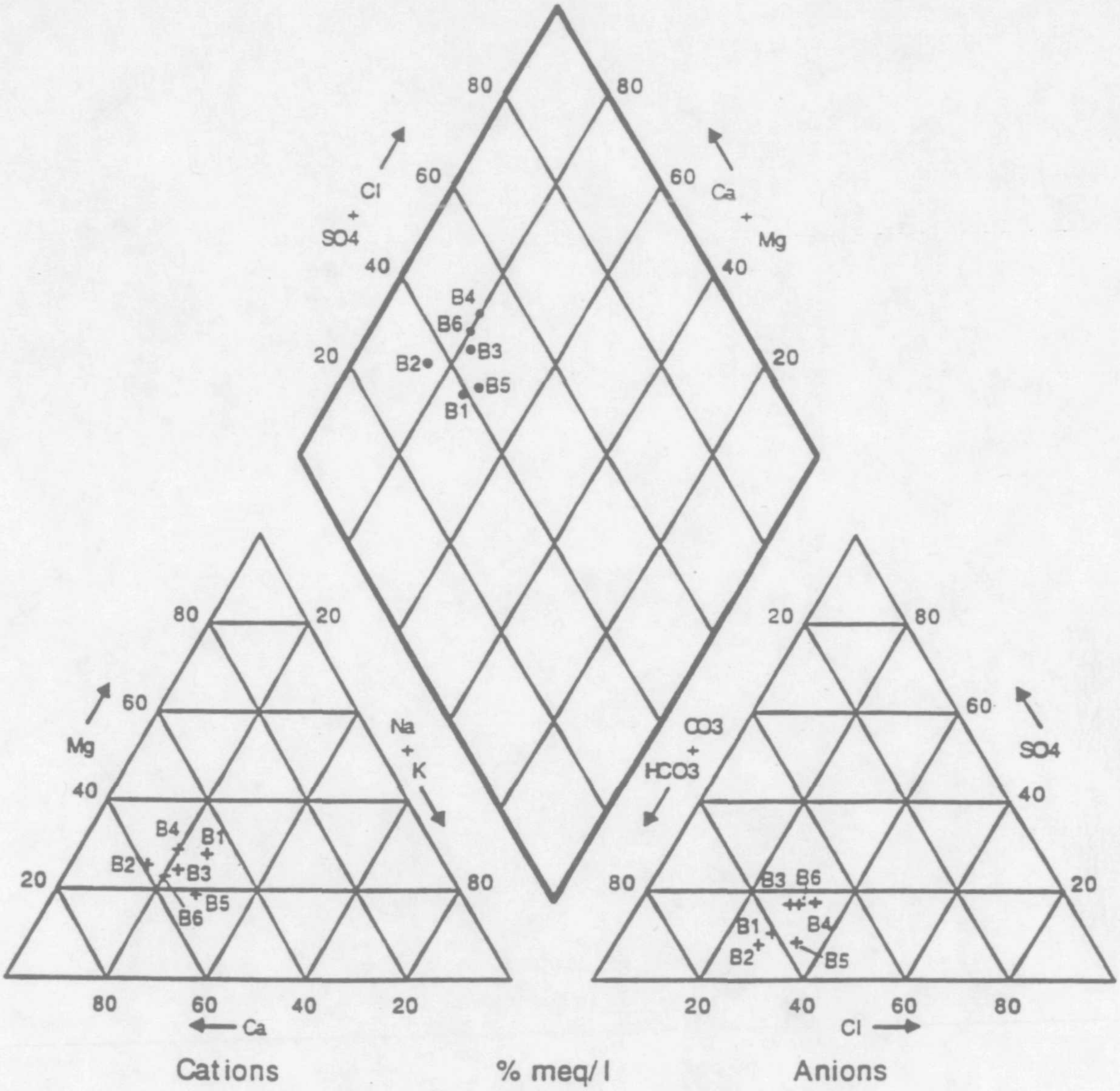
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Piper Diagrams for Michaud, Bannock, and Portneuf Hydrogeochemical Regimes

Job No.	DRAWING No.	REV.
21372	FIGURE 3.3-12A	



No.	TDS	Sample Site
B1	329	Kinport
B2	309	PEI-1
B3	349	106
B4	403	158
B5	271	301
B6	310	305

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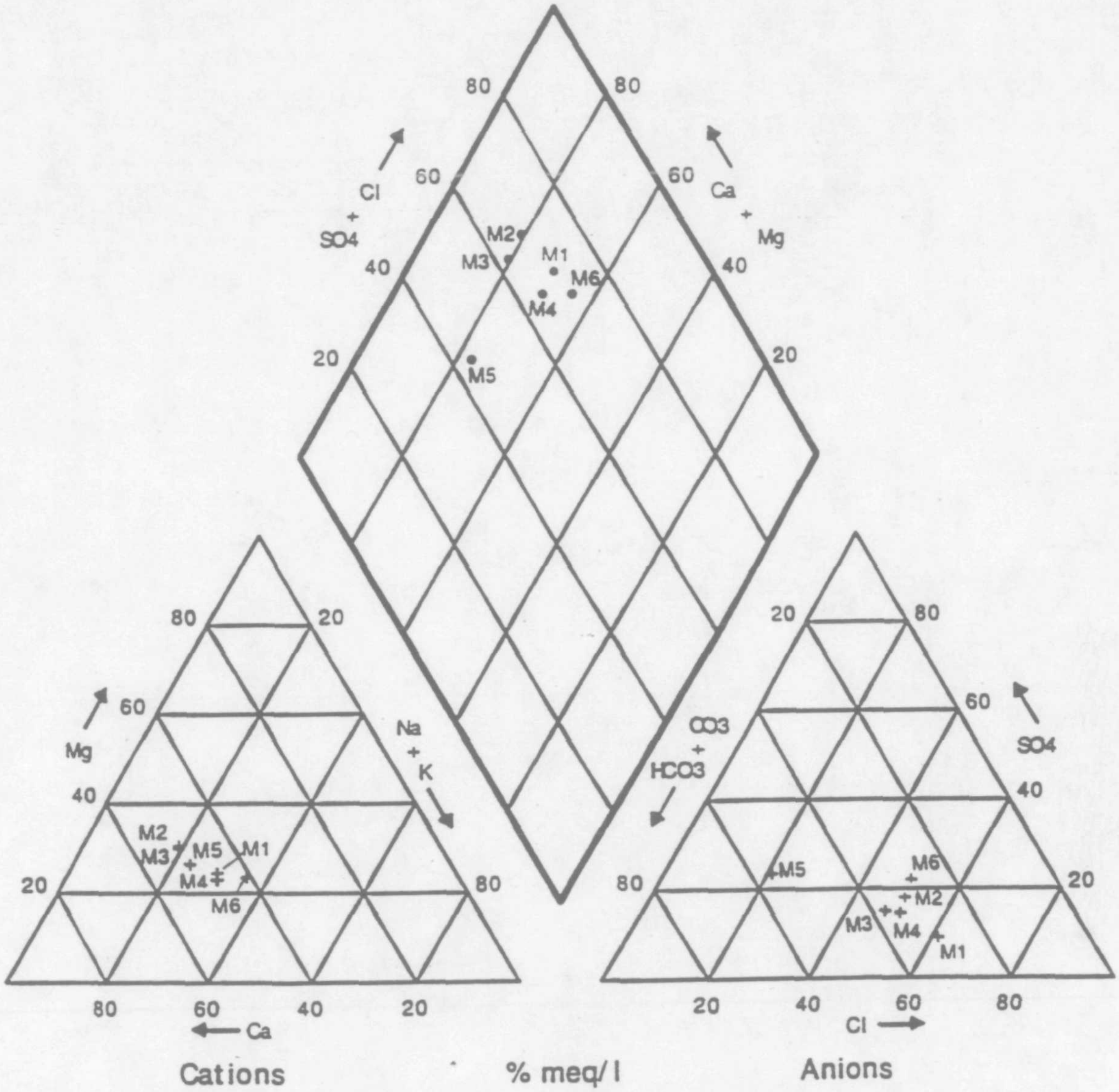
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Piper Diagram for Representative Wells of Bannock Hydrogeochemical Regime

Job No.	DRAWING No.	REV.
21372	FIGURE 3.3-12B	



No.	TDS	Sample Site
M1	512	TW-10S
M2	498	101
M3	448	102
M4	553	147
M5	290	514
M6	713	515

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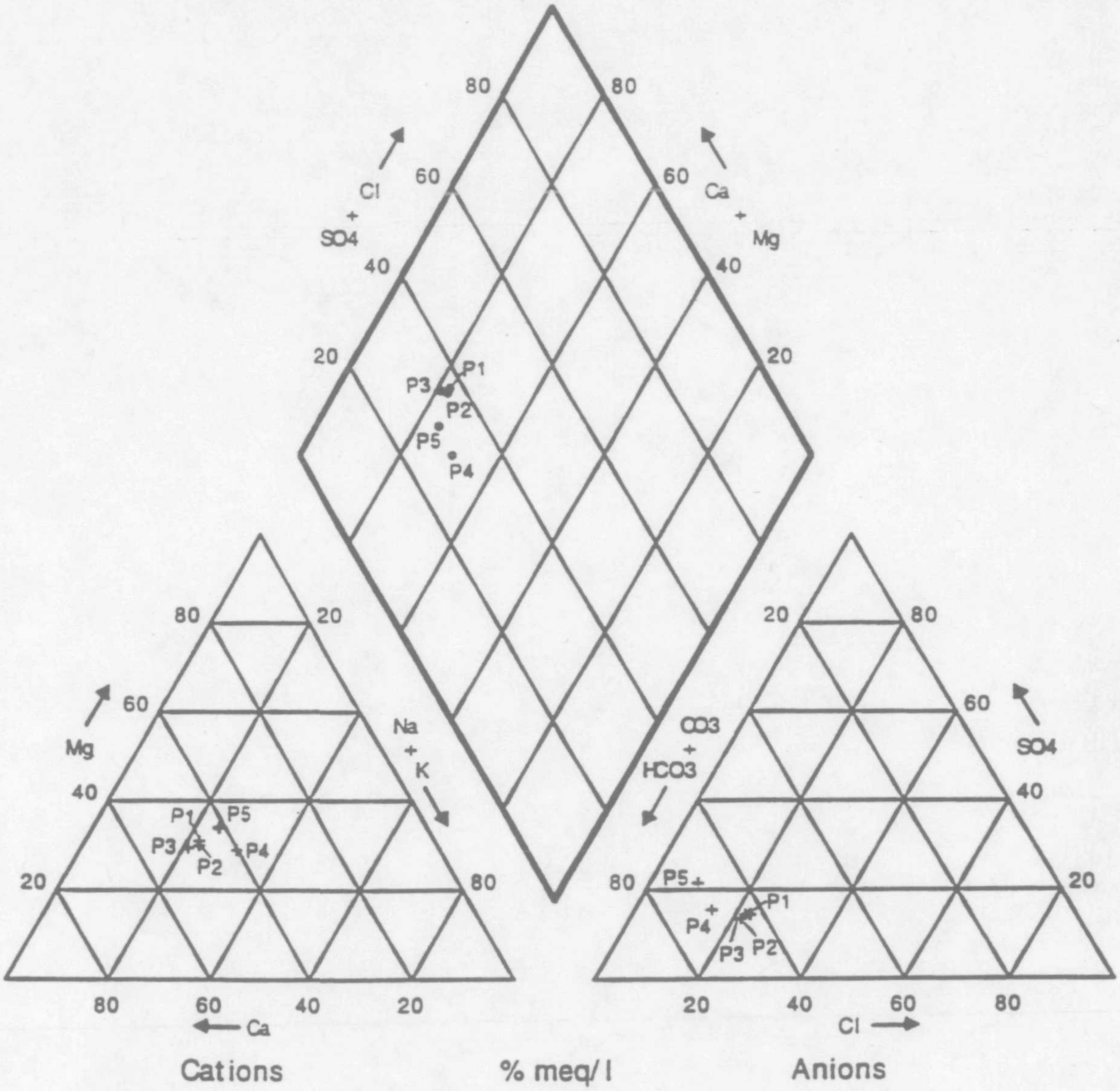
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Piper Diagram for Representative Wells of Michaud Hydrogeochemical Regime

Job No.	DRAWING No.	REV.
21372	FIGURE 3.3-12C	



No.	TDS	Sample Site
P1	566	PEI-6
P2	549	510
P3	551	511
P4	509	512
P5	505	513

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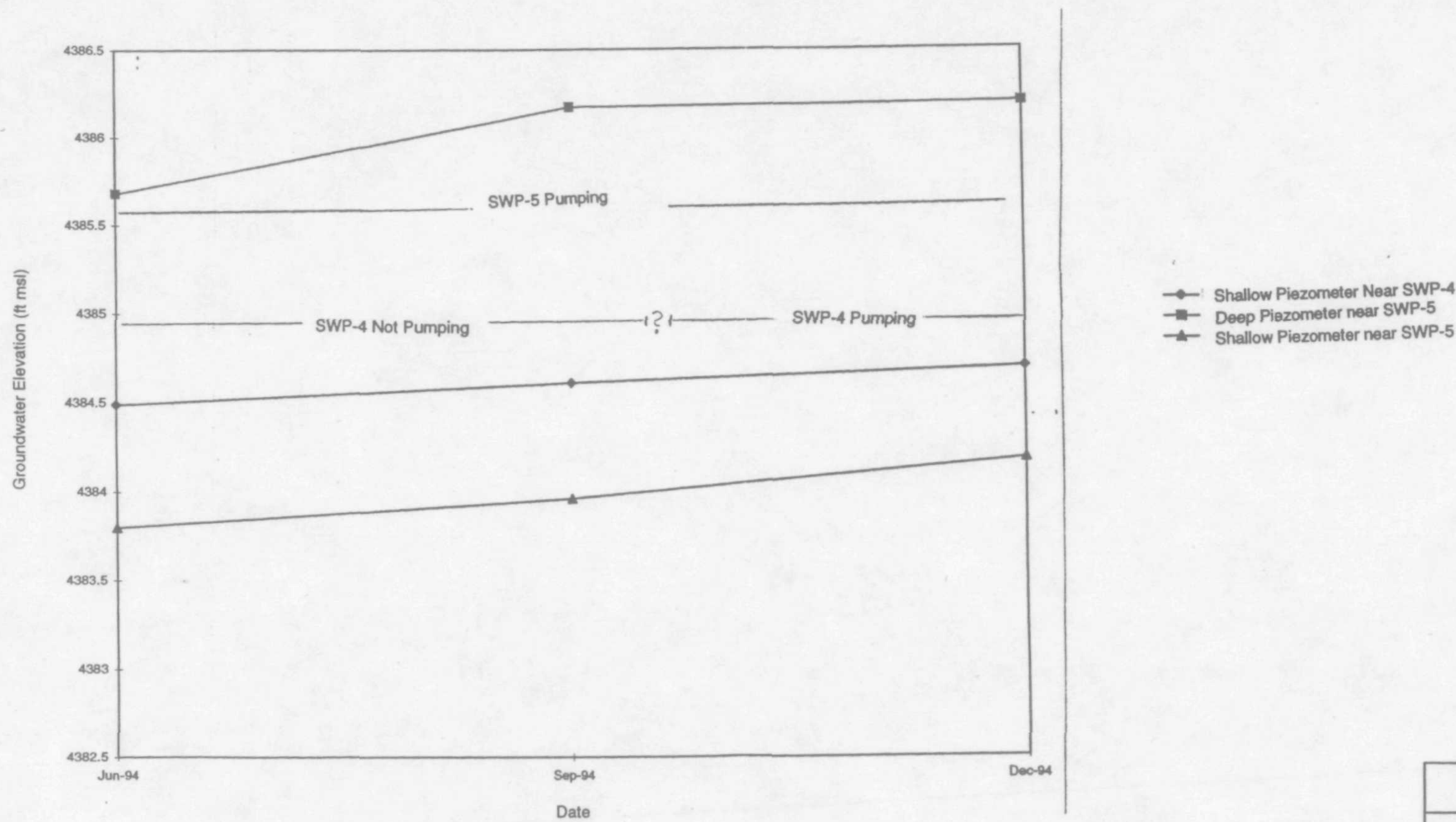
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Piper Diagram for Representative Wells of Portneuf Hydrogeochemical Regime

	Job No.	DRAWING No.	REV.
BECHTEL	21372	FIGURE 3.3-12D	



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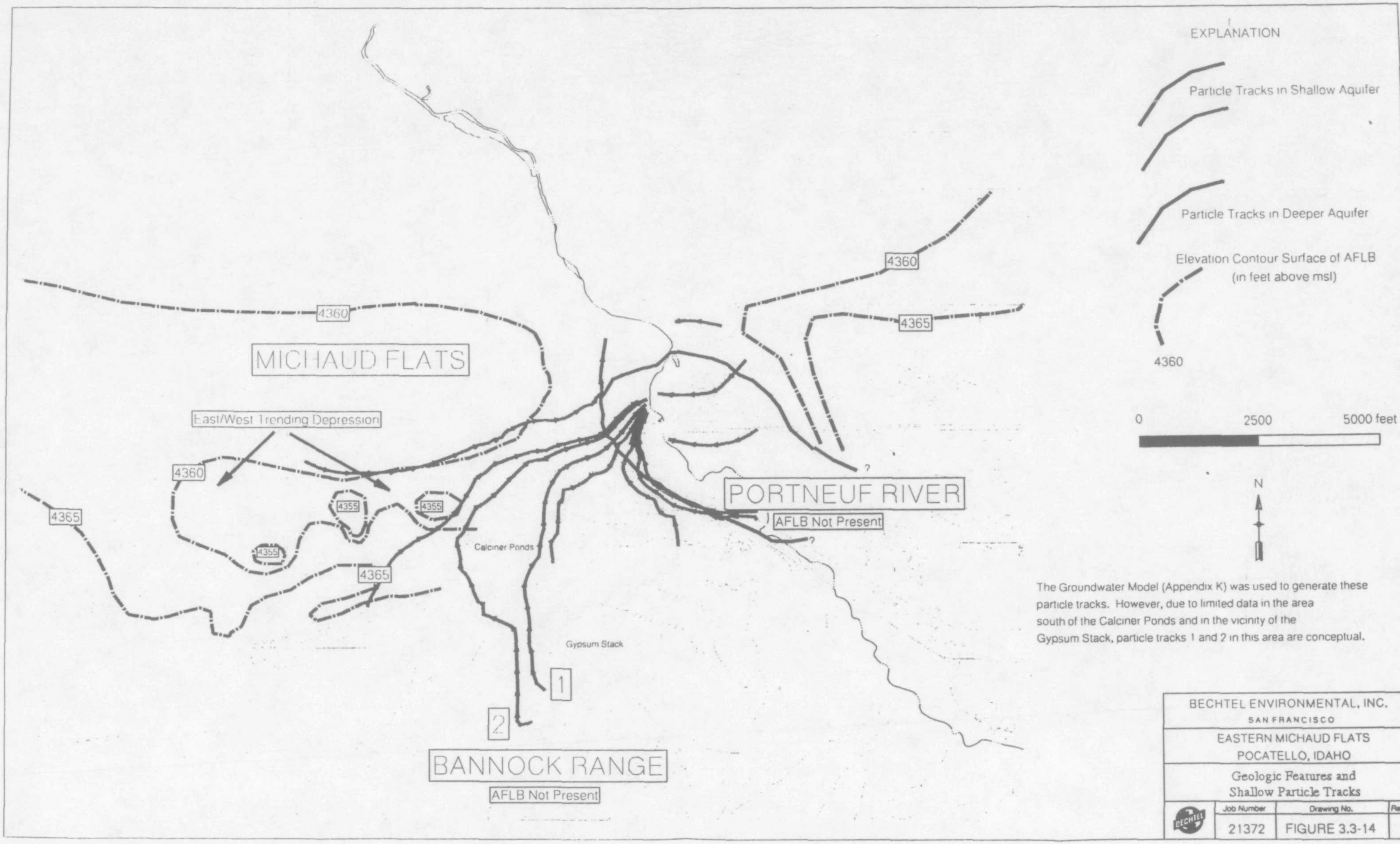
BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO	
EASTERN MICHAUD FLATS POCATELLO, IDAHO	
Hydrographs: Simplot Production Well Piezometers	
Job Number 21372	Drawing No. FIGURE 3.3-13


EXPLANATION
Particle Tracks in Shallow Aquifer
Particle Tracks in Deeper Aquifer
Elevation Contour Surface of AFLB
(in feet above msl)
4360
0
2500
5000 feet
N
MICHAUD FLATS
East/West Trending Depression
4360
4365
4355
4365
PORTNEUF RIVER
AFLB Not Present
Calciner Ponds
Gypsum Stack
1
2
BANNOCK RANGE
AFLB Not Present
The Groundwater Model (Appendix K) was used to generate these particle tracks. However, due to limited data in the area south of the Calciner Ponds and in the vicinity of the Gypsum Stack, particle tracks 1 and 2 in this area are conceptual.
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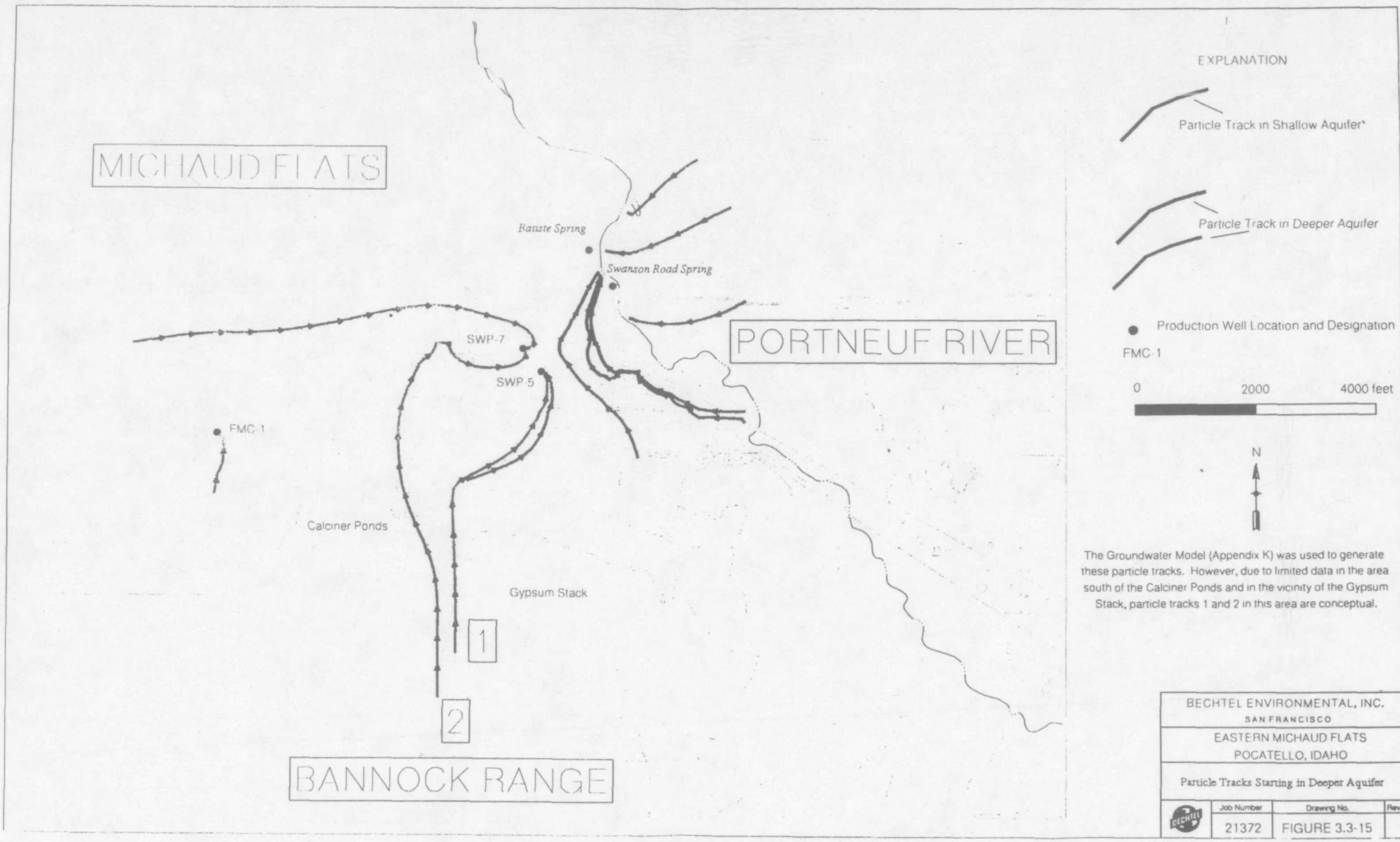
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Geologic Features and
Shallow Particle Tracks
Job Number
Drawing No.
Rev.
21372
FIGURE 3.3-14



MICHAUD FLATS
Batiste Spring
Swanson Road Spring
PORTNEUF RIVER
SWP-7
SWP-5
FMC-1
Calciner Ponds
Gypsum Stack
1
2
BANNOCK RANGE
EXPLANATION
Particle Track in Shallow Aquifer*
Particle Track in Deeper Aquifer
Production Well Location and Designation
FMC-1
0
2000
4000 feet
N
The Groundwater Model (Appendix K) was used to generate these particle tracks. However, due to limited data in the area south of the Calciner Ponds and in the vicinity of the Gypsum Stack, particle tracks 1 and 2 in this area are conceptual.
BECHTEL ENVIRONMENTAL, INC.
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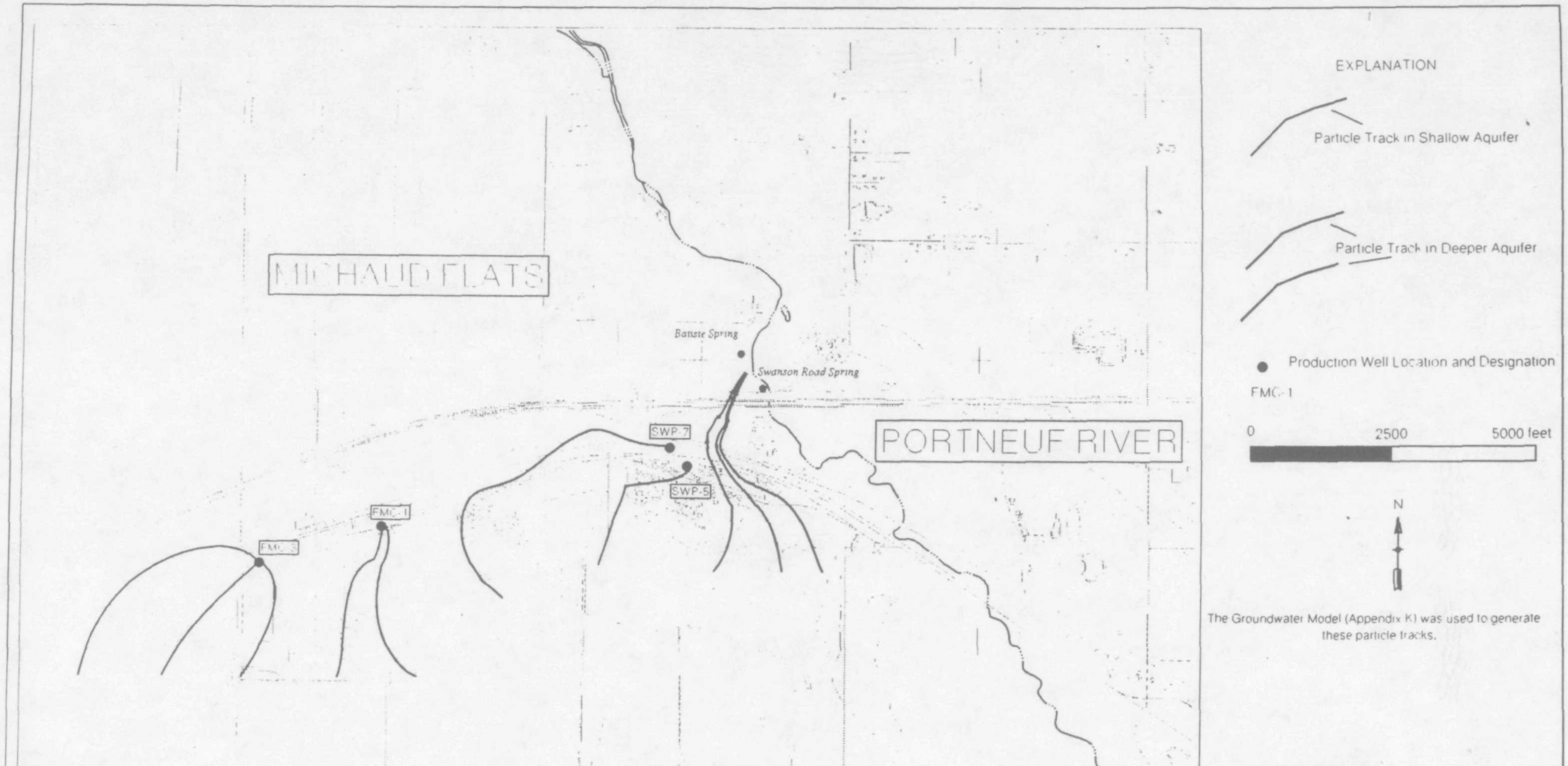
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Particle Tracks Starting in Deeper Aquifer
Job Number
Drawing No.
Rev.
21372
FIGURE 3.3-15



BECHTEL ENVIRONMENTAL, INC.
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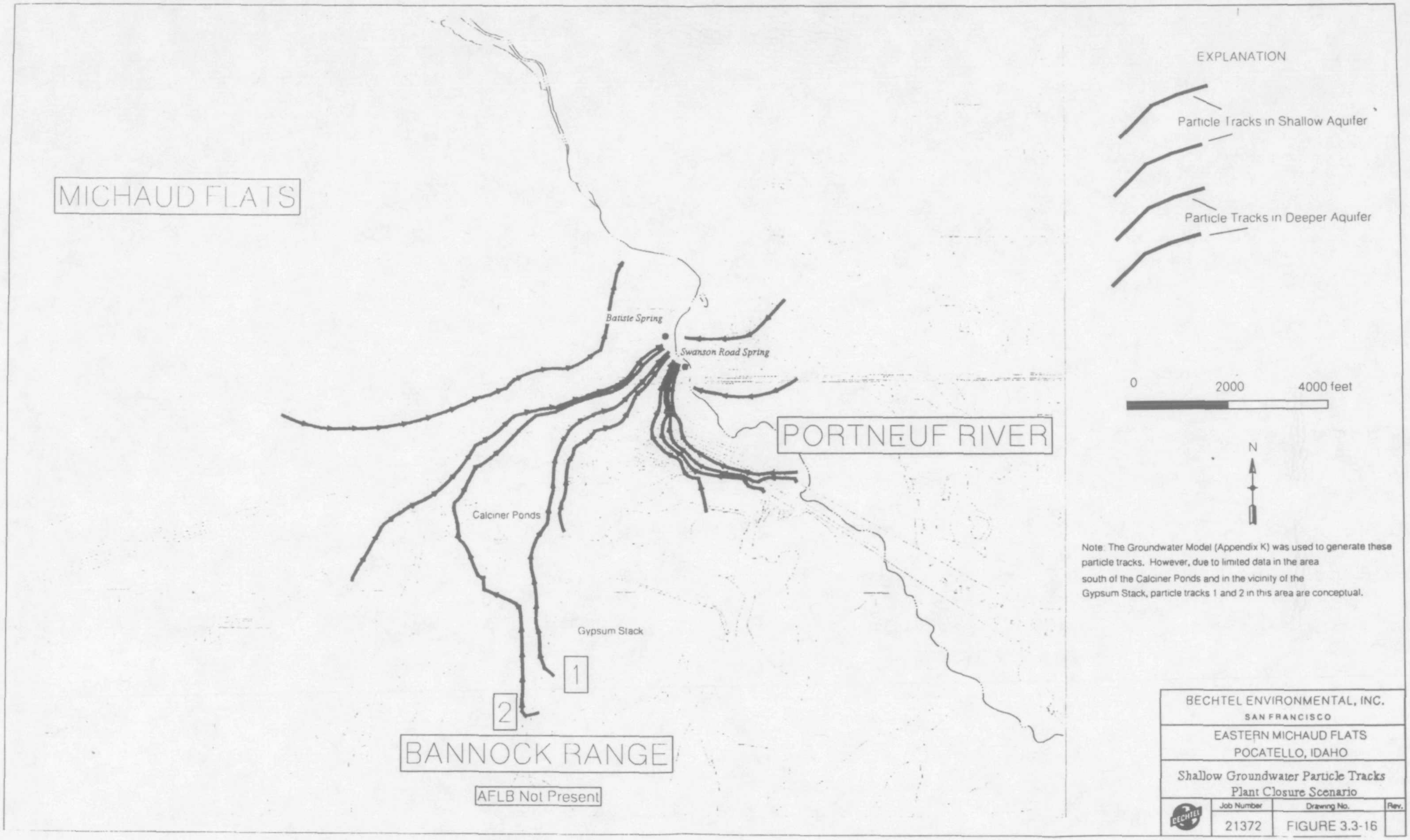
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Effects of Plant Production Wells On Deep Groundwater Flowpaths

Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-15A	


MICHAUD FLATS
Batiste Spring
Swanson Road Spring
PORTNEUF RIVER
Calciner Ponds
Gypsum Stack
1
2
BANNOCK RANGE
AFLB Not Present
EXPLANATION
Particle Tracks in Shallow Aquifer
Particle Tracks in Deeper Aquifer
0
2000
4000 feet
N
Note: The Groundwater Model (Appendix K) was used to generate these particle tracks. However, due to limited data in the area south of the Calciner Ponds and in the vicinity of the Gypsum Stack, particle tracks 1 and 2 in this area are conceptual.
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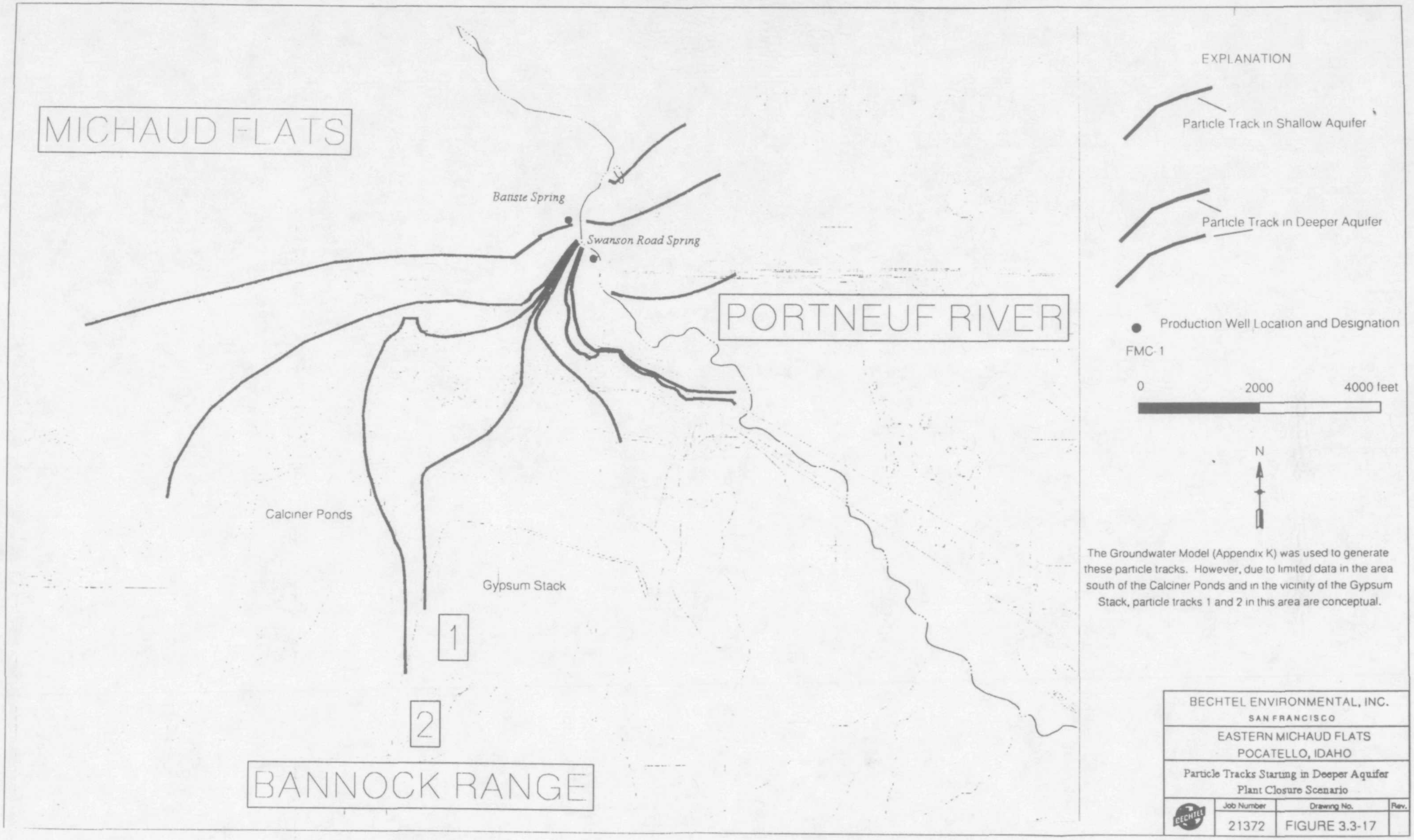
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Shallow Groundwater Particle Tracks
Plant Closure Scenario
Job Number
Drawing No.
Rev.
21372
FIGURE 3.3-16


MICHAUD FLATS
Batiste Spring
Swanson Road Spring
PORTNEUF RIVER
Calciner Ponds
Gypsum Stack
1
2
BANNOCK RANGE
EXPLANATION
Particle Track in Shallow Aquifer
Particle Track in Deeper Aquifer
Production Well Location and Designation
FMC-1
0
2000
4000 feet
N
The Groundwater Model (Appendix K) was used to generate these particle tracks. However, due to limited data in the area south of the Calciner Ponds and in the vicinity of the Gypsum Stack, particle tracks 1 and 2 in this area are conceptual.
BECHTEL ENVIRONMENTAL, INC.
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EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Particle Tracks Starting in Deeper Aquifer
Plant Closure Scenario
Job Number
Drawing No.
Rev.
21372
FIGURE 3.3-17

3.4 STUDY AREA SOILS

This section describes the origin of soils in the EMF study area and their geographical distribution (Section 3.4.1), hydraulic properties (Section 3.4.2), and mineralogical and geochemical properties (Section 3.4.3). Soil descriptions and distribution are based primarily on SCS surveys for the Fort Hall area and Bannock County. Different portions of the facilities fall within the Fort Hall and Bannock County surveys. An overview of study area soils is presented in Figure 3.4-1.

The origin of each soil type is important in determining the properties of the soil. Soils in the EMF study area originate from deposition by rivers and streams (alluvium), collection at the base of slopes (colluvium), weathering in place (residuum), and deposition by wind (loess).

In general, the southern portion of the FMC facility is situated on silty soils primarily derived from loess and colluvium. The soils in the northern portion of the FMC facility are derived primarily from loess and deposits of silty sand and gravel (alluvium). The soils in the southern portion of the Simplot facility are less consistent; the soils in the southwestern area consist of nearly homogeneous silt (loess and silty colluvium), while soils in the southeastern area are more variable and include alluvium, colluvium, and residuum. The soils in the northern portion of the Simplot facility consist primarily of sandy gravels (alluvium) in the central part, with silty soils (loess and fine-grained alluvium) on the east and west.

In terms of hydrogeological properties, study area soils, which consist primarily of silt (loess and some fine-grained colluvium and alluvium), have relatively lower permeability than other soil types. Alluvial soils generally are coarser grained, with correspondingly greater hydraulic conductivity. Alluvial soils also generally have greater hydraulic conductivity in the horizontal direction than in the vertical direction due to the "bedded" nature of their deposition. Hydraulic conductivity of colluvium and residuum is variable, depending on grain size and weathering characteristics of their source materials.

Geochemical characteristics of the soils are a function of the source materials. In general, native soils in the area around Pocatello are alkaline; that is, their pH is greater than 7. This is significant, as alkaline soils tend to retain metals and attenuate their migration (leaching) through the soil horizons to the groundwater (i.e., the greater the soil's alkalinity, the greater the soil's ability to retard migration of the metal ions).

SOIL TYPES (SECTION 3.4.1):	• EMF study area soil descriptions and distribution based on the SCS surveys for the Fort Hall area and Bannock County. • In major portions of both facilities, naturally occurring soils have been modified by mixing with other soils or by-products, or by placement of fill materials (such as slag) over them. • Soil types for both facilities are as follows: Simplot / FMC Simplot: Sandy gravels (alluvium) in central part; silty soils (loess and fine-grained alluvium) on the east and west — FMC: Loess and alluvial deposits Simplot: Homogenous silt (loess and silty alluvium) to the west; more variable (alluvium, colluvium, and residuum) to the east — FMC: Silty soil derived primarily from loess and colluvium
HYDRAULIC PROPERTIES (SECTION 3.4.2):	• Homogenous silt has relatively lower permeability when compared with other study area soil types. • Alluvial soil has greater hydraulic conductivity in the horizontal direction than the vertical. • Other study area soil types are more variable in permeability.
MINERALOGY AND GEOCHEMICAL PROPERTIES (SECTION 3.4.3):	• Under alkaline soil conditions, inorganic chemicals are likely to precipitate and/or adsorb onto soil particles, yielding low poor water concentrations, and, hence, low bioavailability to human and ecological receptors, including plants. • Native soils are generally alkaline due to their calcareous nature.

FIGURE 3.4-1
OVERVIEW OF STUDY AREA SOILS

3.4.1 SOIL TYPES

Soils in the Fort Hall area and Bannock County have been surveyed by the SCS as part of its nationwide soil mapping and classification program. In the SCS surveys, the soil profile is described as extending from the surface down into the underlying unconsolidated material. The underlying unconsolidated material is defined as a region devoid of plant roots, burrowing macroinvertebrates, and microbiological activity. Further, its mineral structure has not been altered by biological activity. In the EMF study area, the underlying unconsolidated materials region begins approximately 2 feet beneath the soil surface.

It should be noted that the soil associations shown in the general soil map for the Fort Hall area soil survey (SCS, 1977) and the Bannock County soil survey (SCS, 1987b) do not entirely match where the survey areas overlap. Differences in soil names from one area to the next are partly a function of the differences in soil patterns and associations, and partly a function of the naming conventions used by SCS personnel. The two soil surveys were conducted nearly 10 years apart.

The major soil associations in the EMF study area that were identified in these two soil surveys are shown in Figure 2.2-3. A soil association consists of one or more major soil types and at least one minor soil type; the soil association is named for the major soils. The soils in one association may occur in another, but in different combinations. The soil associations identified in the Fort Hall area of the EMF study area are Snake-Philbon, Paniogue-Declo, Paniogue-Broncho, and Pocatello-Wheeler-Portneuf. Soil associations in the Bannock County portion of the EMF study area are the Inkom-Joesvar, Arimo-Downey-Bahem, Ririe-Rexburg-Lanoak, and Camelback-Hades-Valmar. Table 3.4-1 summarizes the general characteristics of individual soils within these soil associations. Properties of the soil associations are summarized in Table 2.2-2.

The major portion of the FMC facility is in an area of occurrence of the Pocatello-Wheeler-Portneuf soil association. These soils are described as silt loams, formed primarily in loess (material transported and deposited by wind and consisting of primarily silt-sized particles). The northern portion of the FMC facility extends into an area of the Paniogue-Declo association. These soils are more variable, ranging from gravelly coarse sand to silt loam, developed primarily from alluvial fans and terraces, which accounts for their greater range of particle size and permeability.

Except for the western and southern portions of the FMC facility, these naturally occurring soils have been modified either by mixing with other soils and by-products (such as slag), or by placing slag or other fill materials over them to provide level foundations for facility structures, improve drainage, to provide roads for access, or embankments for ponds.

The southern portion of the Simplot facility is divided between the Ririe-Rexburg-Lanoak (RRL) and the Camelback-Hades-Valmar (CHV) soil associations. The RRL soils are very deep silt loams formed in loess, and are similar to the Pocatello-Wheeler-Portneuf soils. The CHV soils are more variable, ranging in texture from gravelly silt loams to extremely stony silt loams formed in alluvium, colluvium, and residuum.

The northern portion of the Simplot facility extends into the Arimo-Downey-Bahem (ADB) soils and the northeastern corner extends into Inkom-Joesvar (IJ) soils. The ADB soils formed in loess and silty alluvium. This soil association is similar to Paniogue-Declo soils, which occupy a small portion of the northwestern corner of the Simplot facility. Inkom-Joesvar soils are deep, moderately well-drained soils that formed in silty alluvium. Inkom-Joesvar soils occur along the Portneuf River.

Within portions of the Simplot facility, the naturally occurring soils have been modified either by mixing with other soils and by-products (such as gravels and gypsum), or by placing other fill materials over them to provide level foundations for facility structures, improve drainage gradients, or to provide roads for access or embankments for ponds.

3.4.2 Hydraulic Properties

Soil hydraulic properties control the movement of water through the soils, both laterally and vertically. The hydraulic conductivity (permeability) of a soil is a measure of its ability to transmit water through the soil profile. The hydraulic conductivity usually varies with depth within the soil column, as well as laterally with variations in grain size and compaction of the soil.

Most of the study area soils are formed from materials derived from wind-blown (aeolian) or alluvial deposition. On the slopes of the Bannock Hills, some of the soils are derived from colluvium or are residual (formed in place). The depositional process for alluvial deposits results in a "bedded" and "graded" character, which imparts a strong anisotropy to their hydraulic conductivity, especially over large areas. Alluvial deposits tend to vary more widely in hydraulic conductivity than do aeolian materials, typically by two to three orders of magnitude (Freeze and Cherry, 1979). The wide range of hydraulic conductivity reflects the range of the grain-size distribution within the deposit.

In comparison with the alluvial deposits in the study area, aeolian silts (loess) are less permeable and more isotropic in nature, although fractures, root channels, and animal burrows can cause secondary permeability that can greatly exceed the primary permeability of the original soil mass. Typical hydraulic conductivities for unconsolidated soils in the vicinity of the EMF facilities range from about 4×10^{-4} cm /sec for fine-grained soils (silty clays) to greater than 10^{-2} cm/sec for coarse-grained soils (sandy gravels). Typical soil porosities range from 35 to 70 percent for silts and clays, to 25 to 50 percent for sands and gravels (Freeze and Cherry, 1979).

3.4.3 Mineralogy and Geochemical Properties

Soil mineralogy constitutes an important determinant of potential exposure to both human and ecological receptors since only the soluble fraction of an inorganic chemical is typically bioavailable. Bioavailability refers to that fraction of an inorganic which is available for absorption. In soils, the speciation and solubility of metals and trace elements determine the bioavailability of an inorganic and are controlled to a large degree by the soil mineralogy. For example, inorganics may be associated with poorly soluble minerals that are far less likely to dissolve in the gastro-intestinal tract than soluble salts. Alternatively, some inorganics may be encapsulated or coated with other less soluble minerals, further reducing the bioavailability of the inorganic constituents (Davis et al., 1992).

Similarly, mineralogy is also an important determinant of plant root uptake of inorganics from soils. Since plants absorb inorganics primarily from soil pore-water, the solubility of the inorganic in the soil matrix determines the inorganic's bioavailability for plant uptake (Barber, 1984). Inorganic chemical concentrations in soil solution are controlled by solution/precipitation, adsorption/desorption, and ion exchange equilibria (Sposito, 1980).

Under alkaline soil conditions, which exist in study area soils, inorganic chemicals, especially metals, are likely to precipitate and/or adsorb onto soil particles, yielding low pore-water concentrations and, hence, low bioavailability to both humans and ecological receptors, including plants (Sposito, 1980). For example, due to the alkaline and calcareous nature of the study area soils, arsenic may be present primarily in calcium arsenate, enargite, tennantite, arsenopyrite, copper-lead-arsenic oxides and iron-arsenic oxides, and other poorly soluble minerals (Sadiq, 1981; Davis et al., 1992). Soil mineralogical studies were undertaken as described in Section 2.7. Results are reported in Section 4.6.

The native soils in the EMF study area are generally alkaline (pH >7) because of their calcareous nature. This is consistent with most soils in the more arid regions of the western United States (Foth and Turk, 1972). The alkaline pH and calcareous nature of these soils minimize leaching of most metals, because the mobility of most of the metals is closely correlated with soil pH.

Table 3.4-1 includes geochemical data from the SCS soil surveys for the soil associations which occur in the EMF study area. It also provides estimates of texture, permeability, and other general soil properties.

Surface and Subsurface Characterizations
Tables for Section 3.4

TABLE 3.4-1
GENERAL SOIL PROPERTIES: EMF STUDY AREA
POCATELLO, IDAHO

SOIL SERIES	BEDROCK (depth to in inches):	SEASONAL HIGH WATER TABLE	DEPTH FROM SURFACE (in inches)	USDA TEXTURE	UNIFIED SOIL CLASSIFICATION	PERMEABILITY (cm/s)	pH	SALINITY
Paniogue	>60	>60	0 - 28	Loam and silt loam	ML or CL-ML	$4x10^{-4}$ - $1.4x10^{-3}$	7.4-9.6	Low, except moderate in some areas
			28 - 60	Coarse sand and gravelly coarse sand	SP or SP-SM	>$1.4x10^{-2}$	8.5-9.0	
Declo	>60	>60	0 - 47	Loam and silt loam	ML	$4x10^{-4}$ - $1.4x10^{-3}$	7.4-8.4	None
			47 - 60	Loamy coarse sand and coarse sand	SM	$4x10^{-3}$ - $1.4x10^{-2}$	7.9-8.4	None
Pocatello	>60	>60	0 - 60	Silt loam	ML	$4x10^{-3}$ - $1.4x10^{-2}$	7.9-9.6	None
Wheeler	>60	>60	0 - 60	Silt loam	ML	$4x10^{-3}$ - $1.4x10^{-2}$	7.4-8.4	None
Portneuf	>60	>60	0 - 60	Silt loam	ML, CL, or CL-ML	$4x10^{-3}$ - $1.4x10^{-2}$	6.6-9.0	None above a depth of 24", moderate below 24"
Inkom	>60	24-48	0 - 7	Silt loam	ML, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	7.4-8.4	<4 mmhos/cm
			7 - 60	Silt loam	CL, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	7.4-8.4	<4 mmhos/cm
Joevar	>60	>72	0 - 4	Silt loam	ML, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.6-7.8	<2 mmhos/cm
			4 - 60	Silt loam	ML, CL-ML		7.4-8.4	<2 mmhos/cm
Arimo	>60	>72	0 - 18	Silt loam	ML, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.6-7.8	<2 mmhos/cm
			18 - 33	Silt loam	ML, CL-ML	>$1.4x10^{-2}$	7.4-8.4	<2 mmhos/cm
			33 - 60	Extremely gravelly coarse sand	GP		7.4-8.4	<2 mmhos/cm
Downey	>60	>72	0 - 17	Gravelly silt loam	CL-ML, ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.6-8.4	<2 mmhos/cm
			17 - 60	Very gravelly coarse sand, extremely gravelly coarse sand	GP	>10^{-2}	7.4-8.4	<2 mmhos/cm

Source: SCS (1987b).

Note: Permeability units reported in SCS reports use length over time (inches per hour). Hydrogeology convention would use the term hydraulic conductivity.

TABLE 3.4-1 *(continued)*
GENERAL SOIL PROPERTIES: EMF STUDY AREA
POCATELLO, IDAHO

SOIL SERIES	BEDROCK (depth to in inches):	SEASONAL HIGH WATER TABLE	DEPTH FROM SURFACE (in inches)	USDA TEXTURE	UNIFIED SOIL CLASSIFICATION	PERMEABILITY (cm/s)	pH	SALINITY
Bahem	>60	>72	0 - 11	Silt loam	ML, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	7.4-7.8	<2 mmhos/cm
			11 - 49	Silt loam, silt	ML, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	7.4-8.4	<2 mmhos/cm
			49 - 60	Extremely cobbly sand, extremely stony sand	GP, SP	$>10^{-2}$	---	<2 mmhos/cm
Ririe	>60	>72	0 - 12	Silt loam	ML, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.6-8.4	<2 mmhos/cm
			12 - 60	Silt loam	ML, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	7.4-9.0	<2 mmhos/cm
Rexburg	>60	>72	0 - 10	Silt loam	ML, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.1-7.8	<2 mmhos/cm
			10 - 26	Silt loam	ML, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.6-7.8	<2 mmhos/cm
			26 - 60	Silt loam, silt	ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	7.4-8.4	<2 mmhos/cm
Lanoak	>60	>72	0 - 22	Silt loam	ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.1-7.8	<2 mmhos/cm
			22 - 60	Silt loam	CL, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.6-7.8	<2 mmhos/cm
Camelback	>60	>72	0 - 21	Extremely stony silt loam	GM-GC, GM	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.1-7.3	<2 mmhos/cm
			21 - 60	Extremely gravelly silt loam, extremely cobbly silt loam	GM-GC, GC	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.1-7.3	<2 mmhos/cm
Hades	>60	>72	0 - 7	Gravelly silt loam	CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	5.6-7.3	<2 mmhos/cm
			7 - 60	Gravelly silt loam, gravelly silty clay loam	CL, GC	$1.4x10^{-4}$ - $4.2x10^{-4}$	5.6-8.4	<2 mmhos/cm
Valmar	20-40	>72	0 - 9	Very cobbly silt loam	GM, GM-GC	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.1-7.3	<2 mmhos/cm
			9 - 14	Very stony silt loam, very cobbly silt loam.	GM-GC, GC	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.6-7.8	<2 mmhos/cm
			14 - 24	Extremely stony silt loam, extremely flaggy silt loam	GM-GC, GC	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.6-7.8	<2 mmhos/cm
			24	Unweathered bedrock	---	---	---	---

Source: SCS (1987b).

Note: Permeability units reported in SCS reports use length over time (inches per hour). Hydrogeology convention would use the term hydraulic conductivity.

3.5 CLIMATE

This section characterizes the EMF study area climate (Section 3.5.1) and summarizes analyses of meteorological data gathered at three monitoring stations in the EMF study area (Section 3.5.2). An overview of EMF study area climate is presented in Figure 3.5-1. A discussion of meteorological data collected during the RI, as part of the EMF air monitoring program, is provided in RI Report Part III.

The EMF study area climate is semi-arid, characterized by a wide range of temperatures. Daily mean maximum temperature is 88.6°F (31.4°C) in the summer, and daily mean minimum temperature is 15.1°F (-9.4°C) in the winter. The annual mean precipitation for the study area is 10.86 in/yr (384 mm/yr), with the greatest amount of precipitation occurring during the spring. Prevailing winds are southwesterly for the region.

Section 3.5.2 discusses data obtained by Simplot from two meteorological stations located closest to the EMF facilities. Comparisons of the National Weather Service (NWS) Pocatello data, collected at the Pocatello airport, with data from the two Simplot stations show differences, primarily in wind direction, windspeed, and temperature. These can be attributed to the effects of local terrain on the meteorological parameters.

CLIMATOLOGICAL DESCRIPTION (SECTION 3.5.1):	• EMF study area climate is semi-arid, characterized by a wide range of temperatures, with a reversal of wet winter/dry summer pattern. • Maximum recorded 24-hour precipitation (water equivalent) in the last 40 years was 1.82 inches in 1976; annual mean precipitation is 10.8 inches per year. Mean evaporation during summer is 29.76 inches, and 3.36 inches during the winter. • Predominant wind direction is from the southwest, with a mean annual windspeed of 10.1 mph.
SITE-SPECIFIC METEOROLOGICAL DATA (SECTION 3.5.2):	• Comparison of data from the NWS Pocatello, Simplot site 1, and Simplot site 7 meteorological stations shows that differences in wind direction, wind speed, and temperature (Tables 3.5-1 to 3.5-3) are attributable to the effects of local terrain on meteorological parameters.

FIGURE 3.5-1
OVERVIEW OF THE EMF STUDY AREA CLIMATE

3.5.1 CLIMATOLOGICAL DESCRIPTION

The EMF study area is located on the border of the upper Snake River Plains and Eastern Highlands climatic regions in southeastern Idaho (NOAA, 1982). Storms originating over the Pacific Ocean are the primary sources of precipitation in Idaho. Exceptions occur in the summer, when high levels of moisture-laden air brought in from the Gulf of Mexico and Caribbean region produce thundershowers (Ruffner, 1978).

The climate of eastern Idaho is influenced by Maritime Pacific air that is advected eastward by the prevailing westerly winds. The effects of the maritime air are most noticeable in the winter, which is characterized by greater average cloudiness, higher frequency of precipitation, and mean temperatures above those at locations of the same altitude and latitude in the mid-continent area (Ruffner, 1978). Eastern Idaho's climate is characterized by a wide range of temperatures between winter and summer and a reversal of the wet winter/dry summer pattern. The annual average percentage of sunshine is about 64 percent, which drops to 45 percent during the cloudy months of winter (NOAA, 1994).

The highest temperature recorded at the Pocatello Municipal Airport was 104°F (40°C) in August 1990. The lowest temperature recorded at the Pocatello airport was -33°F (-36°C) in February 1985. The warmest temperatures occur from June through August [daily mean maximum temperature 88.6°F (31.4°C)], and the coldest temperatures occur from December through February [with daily mean minimum temperature of 15.1°F (-9.4°C)] (NOAA, 1994).

The maximum mean number of days with thunderstorms recorded for a 3-month period was 15.4 days, which occurred during the summer. Thunderstorms occur mainly in the afternoon and are usually brief. Because of the dryness of the air, little rainfall reaches the ground (NOAA, 1994). The maximum mean number of days with heavy fog visibility, 0.25 mile (0.4 km) or less, occurred during the winter months. The mean number of days with heavy fog was 12 for the winter months.

The greatest amount of precipitation (3.33 inches, or 84.6 mm, for a 3-month period) occurs during the spring, March through May, and the least amount occurs during the next 3-month period (3.30 inches, or 83.8 mm). The maximum monthly precipitation (water equivalent) recorded at the Pocatello airport was 3.98 inches (102.1 mm) in August 1968. The minimum monthly precipitation (water equivalent) recorded at the Pocatello airport was in October 1988, when there was no precipitation. The maximum 24-hour precipitation (water equivalent) recorded at the Pocatello airport was 1.82 inches (46.7 mm) in October 1976. The maximum monthly snowfall recorded at the Pocatello airport was 33.7 inches (864.1 mm) in December 1983, and the maximum snowfall recorded during the winter months of 1992-1993 was 93.3 inches (2,370 mm). The annual mean precipitation for the EMF study area is 10.8 in/yr (274 mm/yr). These data are based on approximately 40 years of climatological data gathered at Pocatello, Idaho (NOAA, 1994).

The predominant wind direction is from the southwest, and the mean annual wind speed is 10.1 miles per hour (mph) (16.1 km per hour, or kmph) as measured at the airport. Simplot's data show that localized topography (Bannock Range) influences wind direction in the vicinity of the facilities. The peak wind gust recorded at the airport was 68 mph (109 kmph) from the southwest in January 1990 (NOAA, 1994).

The mean evaporation during the summer is 29.76 inches (762 mm) for the 3-month period, and 3.36 inches (86 mm) for the winter months. Mean evaporation was estimated with a form of the Penman equation using the parameters of wind speed, mean air temperature, mean dew point temperature, and daily solar radiation (NOAA, 1982).

3.5.2 SITE-SPECIFIC METEOROLOGICAL DATA

Existing meteorological data were gathered and reviewed. Data compared were taken from three meteorological stations: NWS Pocatello (located at the Pocatello airport) and Simplot sites 1 and 7. The NWS meteorological data were for the years 1985 to 1989. These were the only data available from EPA's bulletin board service and the National Climatic Data Center (NCDC). Simplot's site 1 data were for the years 1981 to 1983 and 1988 through 1991; site 7 data were for the years from 1988 to 1991.

A comparison of the Pocatello airport and Simplot meteorological site 1 data shows that, although the two stations are only about 4 miles (6.4 km) apart, the local topography of the Bannock Range influences the local wind patterns. This influence is evidenced by wind roses of the two locations provided in Figures 3.5-2 and 3.5-3. The Pocatello airport data (Figure 3.5-2) show a prevailing wind direction from the south-southwest, with a strong predominance of wind from the entire southwest quadrant. The site 1 data (Figure 3.5-3) show a strong predominance for southwest to west-southwest winds and a secondary predominance from the southeast.

Meteorological data summaries of monthly mean values for the three monitoring sites are presented in Tables 3.5-1 through 3.5-3 for the NWS station and Simplot sites 1 and 7, respectively. These tables contain wind speed, wind direction, and temperature for the available years of data. The temperatures and wind speeds at the NWS station are generally higher than at site 1 and site 7. These differences are caused by the locations of the sites. Site 1 is located in gently rolling hills and is affected by mountain/valley influences of the Bannock Range. Site 7 is in the Bannock Range at a higher elevation than the NWS and site 1 stations. The NWS station is in a more open area of the EMF plain and is exposed to more heating and free wind flow than sites 1 and 7. In addition, the close proximity to the Bannock Range shields sites 1 and 7 from winds.

Surface and Subsurface Characterizations
Tables for Section 3.5

TABLE 3.5-1
NATIONAL WEATHER SERVICE — POCATELLO
METEOROLOGICAL DATA SUMMARY MONTHLY MEAN VALUES

PARAMETER	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Wind	1985	5.8	9.6	9.4	11.6	10.5	9.8	8.3	10.1	10.1	11.4	11.9	6.0	9.5
Speed	1986	9.6	13.0	11.0	12.3	11.2	9.8	10.7	8.3	9.2	8.1	12.1	6.0	10.1
(mph)	1987	8.9	9.6	11.2	11.0	10.1	9.6	9.6	9.6	8.5	7.6	8.5	11.4	9.6
	1988	11.2	11.0	13.9	11.6	11.4	3.8	10.3	9.8	10.1	9.4	13.4	9.2	10.4
	1989	12.1	9.4	11.6	12.1	11.0	9.4	8.1	9.4	9.4	9.8	10.3	7.8	10.0
Wind	1985	330.8	321.7	309.3	283.5	198.3	208.1	322.9	219.2	189.3	194.1	182.9	345.5	258.8
Direction	1986	344.4	190.3	211.6	205.3	202.1	205.3	209.1	310.8	203.6	180.7	196.6	335.1	232.9
(°)	1987	179.4	175.7	181.6	202.3	207.5	206.5	199.7	202.2	212.5	186.8	179.7	181.7	192.9
	1988	166.9	181.2	191.8	201.7	209.0	212.1	223.2	206.6	200.6	205.1	205.2	342.3	212.1
	1989	178.9	311.1	200.5	195.6	221.1	197.5	209.1	212.1	176.6	199.0	193.0	308.4	216.9
Temperature	1985	-10.5	-7.3	-2.5	9.8	13.7	18.3	22.8	19.6	12.2	7.8	-2.8	-11.8	5.8
(°C)	1986	-4.9	1.7	6.7	7.2	12.2	19.9	19.8	22.0	12.1	8.4	2.2	-4.7	8.6
	1987	-6.6	0.3	4.0	11.5	14.5	18.8	20.0	20.1	16.3	10.1	2.0	-3.1	9.0
	1988	-5.7	0.0	3.0	9.6	12.9	21.1	23.8	21.3	14.8	12.9	2.0	-5.8	9.2
	1989	-6.7	-7.1	3.3	9.6	12.2	17.5	23.2	19.6	15.6	8.3	2.5	-3.4	7.9

TABLE 3.5-2
SIMPLOT SITE 1
METEOROLOGICAL DATA SUMMARY MONTHLY MEAN VALUES

PARAMETER	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Wind Speed (mph)	1981	9.5	10.3	10.5	12.9	13.2	14.9	12.5	10.1	9.6	9.5	9.7	12.3	11.3
	1982	13.4	10.3	13.1	12.5	12.2	9.7	9.8	10.2	10.3	10.3	9.0	10.7	11.0
	1983	9.4	10.2	10.7	10.1	11.6	11.1	11.5	8.8	10.7	8.0	11.4	8.0	10.1
	1988	10.0	11.0	N/A	N/A	9.9	6.6	5.7	N/A	6.9	6.7	12.2	7.5	6.4
	1989	10.4	8.4	11.2	10.2	8.6	9.3	8.0	9.4	9.1	9.5	10.4	7.4	9.3
	1990	11.5	11.4	9.9	10.5	10.7	10.6	9.2	8.4	7.1	12.0	12.1	N/A	9.5
Wind Direction (°)	1981	157.8	187.8	191.0	209.4	201.9	206.0	197.7	191.9	201.3	188.9	177.7	199.0	192.5
	1982	209.3	173.5	196.1	207.7	202.1	195.5	194.1	19.4	183.4	197.7	185.4	200.1	180.4
	1983	197.1	201.8	191.8	176.7	196.9	196.9	185.4	181.4	197.1	189.3	190.0	329.5	202.8
	1988	190.5	174.1	193.7	N/A	195.6	182.7	209.6	N/A	195.7	179.5	197.3	346.2	206.4
	1989	194.5	316.2	196.6	187.6	206.1	183.5	186.7	193.5	177.7	190.2	202.1	319.2	212.8
	1990	191.5	195.3	186.2	183.5	186.3	194.6	204.4	190.6	359.5	208.9	186.1	N/A	207.9
Temperature (°C)	1981	-1.3	-1.3	3.5	9.2	10.0	16.6	22.1	23.2	17.3	7.3	3.3	-1.2	9.1
	1982	-5.6	-4.7	3.2	5.4	10.7	17.1	20.8	22.0	13.9	7.2	-0.4	-3.1	7.2
	1983	-0.5	0.2	4.0	5.9	12.2	17.2	20.9	22.9	14.5	8.6	3.6	-6.5	8.6
	1988	-3.9	0.6	3.3	10.0	12.9	21.3	22.3	N/A	13.4	12.0	0.6	-6.6	7.2
	1989	-7.6	-6.7	2.2	8.4	10.6	16.2	22.1	18.3	14.6	7.5	2.1	-3.7	7.0
	1990	-1.8	-2.5	3.8	9.1	9.9	16.2	20.5	19.9	17.4	8.0	1.6	N/A	8.5

N/A = Not available due to less than 75 percent data recovery for the month/year.

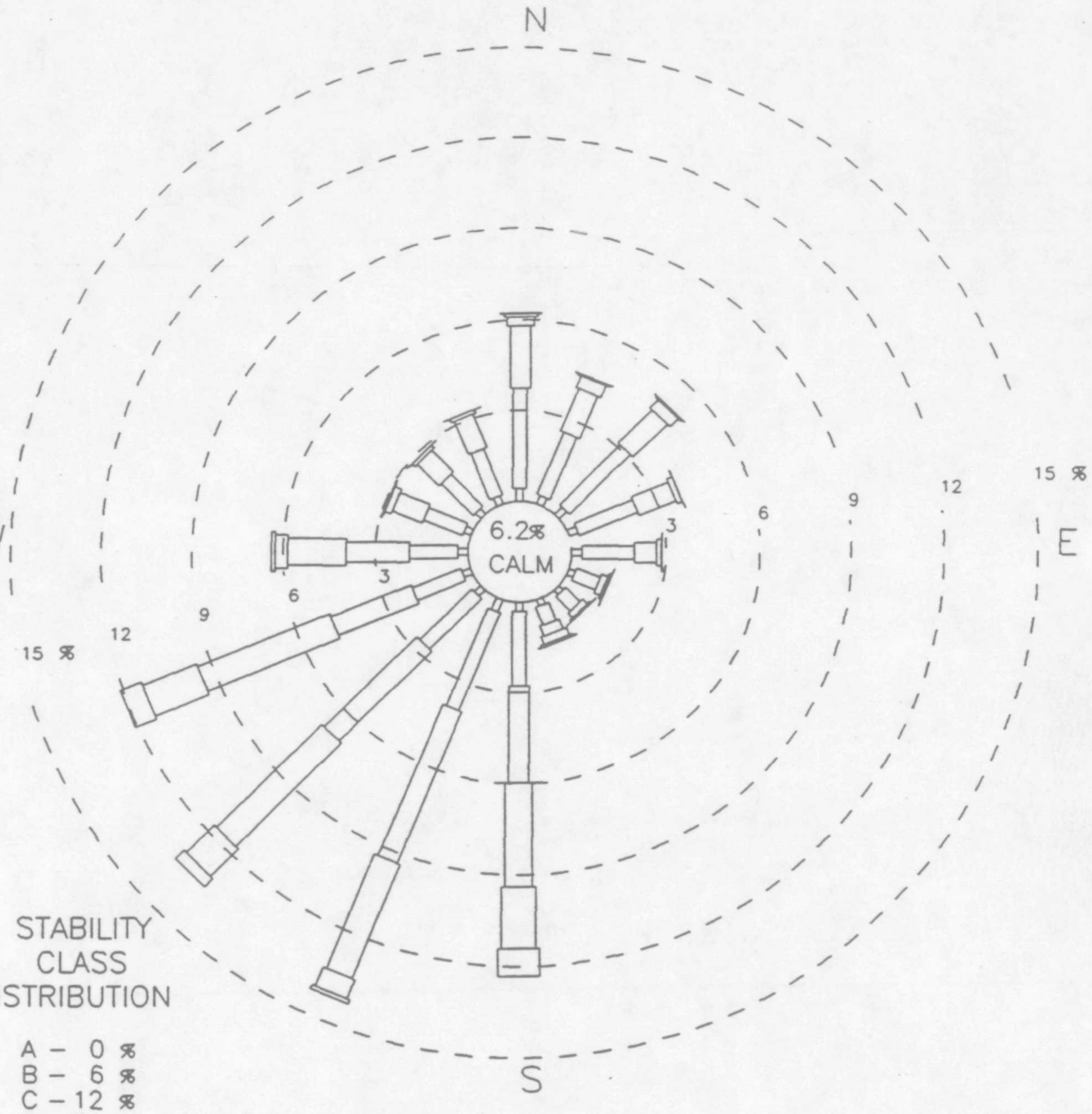
TABLE 3.5-3
SIMPLOT SITE 7
METEOROLOGICAL DATA SUMMARY MONTHLY MEAN VALUES

PARAMETER	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Wind	1988	11.8	12.8	15.9	N/A	8.3	6.7	17.5	N/A	8.9	N/A	11.5	N/A	7.8
Speed	1989	10.3	10.4	12.7	13.0	11.9	8.2	6.4	7.9	7.5	8.0	10.3	N/A	8.9
(mph)	1990	10.3	10.4	9.9	9.5	8.8	9.9	N/A	6.4	5.4	10.4	9.8	7.2	8.2
Wind	1988	150.1	148.7	164.9	N/A	170.9	180.6	125.7	N/A	N/A	N/A	N/A	N/A	N/A
Direction	1989	N/A	N/A	N/A	N/A	N/A	192.4	210.0	206.1	192.1	214.6	220.3	N/A	N/A
(°)	1990	211.4	208.1	207.5	204.8	204.4	216.4	N/A	200.5	200.0	204.9	194.4	201.4	187.8
Temperature	1988	-4.8	0.3	2.6	8.2	10.5	18.9	N/A	N/A	11.6	10.9	-1.6	-7.4	4.1
(°C)	1989	-6.6	-6.9	3.0	9.2	11.5	17.0	21.4	16.5	13.1	6.2	0.6	-5.1	6.7
	1990	-3.8	-4.4	1.5	7.2	7.6	14.4	N/A	16.6	15.9	6.2	0.2	-11.5	4.2

N/A = Not available due to less than 75 percent data recovery for the month/year.

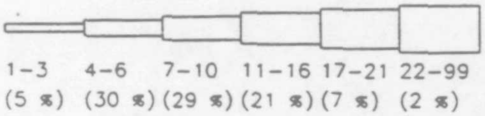
Surface and Subsurface Characterizations
Figures for Section 3.5

Pocatello, Idaho



STABILITY
CLASS
DISTRIBUTION

A – 0 %
B – 6 %
C – 12 %
D – 51 %
E – 15 %
F – 15 %

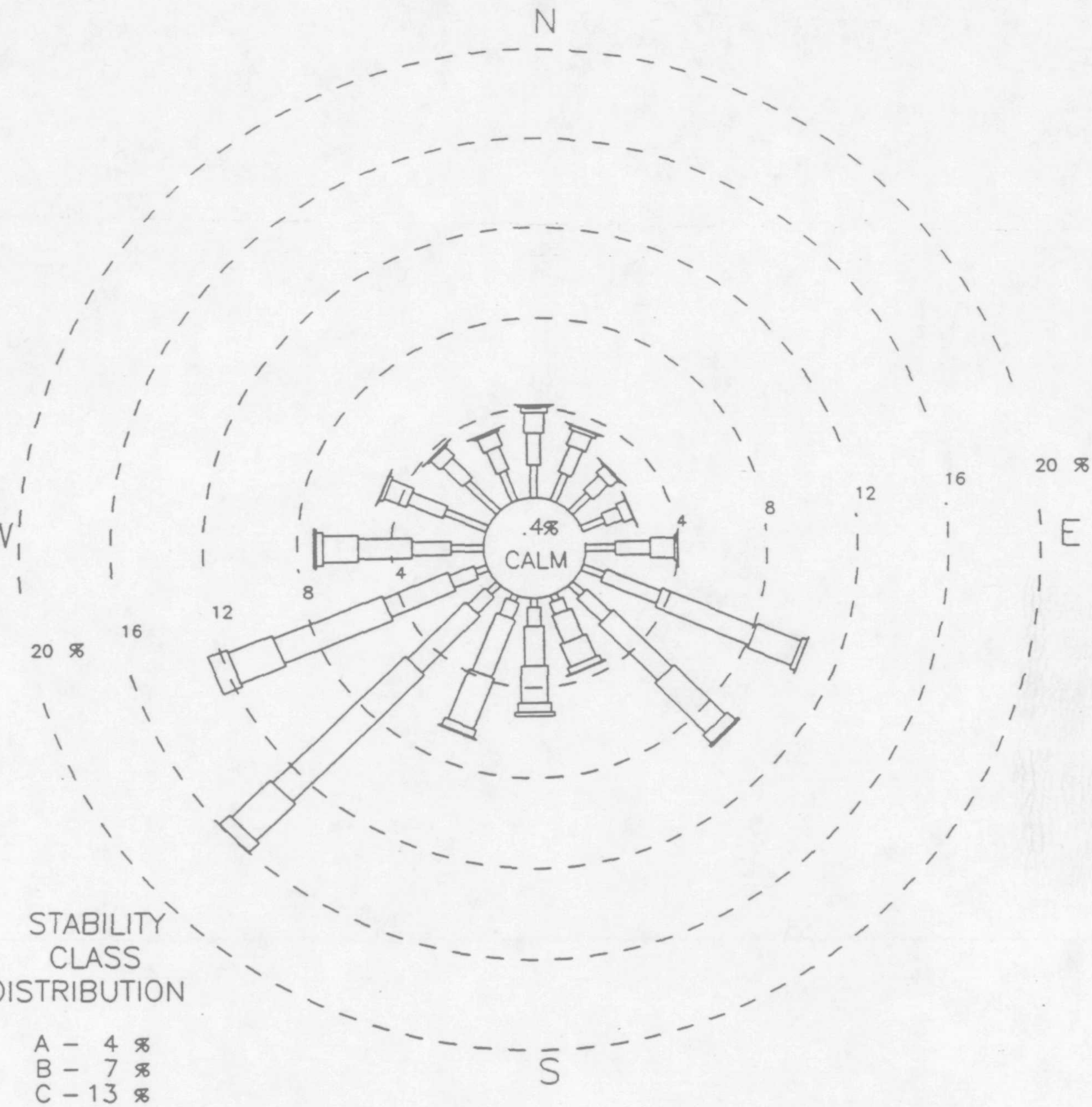


WIND SPEED SCALE (KNOTS)

NOTE – WIND DIRECTION IS THE DIRECTION WIND IS BLOWING FROM

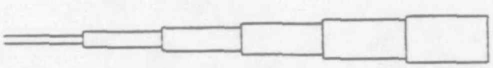
BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Wind Rose, Pocatello Airport 1984 to 1989		
JOB No.	DRAWING NO.	REV.
21372	FIGURE 3.5-2	

JRS SITE 1 (STP) 1981 – 83, 1988, & 1989



STABILITY
CLASS
DISTRIBUTION

A – 4 %
B – 7 %
C – 13 %
D – 53 %
E – 13 %
F – 12 %



WIND SPEED SCALE (KNOTS)

NOTE – WIND DIRECTION IS THE DIRECTION WIND IS BLOWING FROM

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Wind Rose, Simplot Site 1
5-Year Composite

	JOB No.	DRAWING NO.	REV.
BECHTEL	21372	FIGURE 3.5-3	

3.6 DEMOGRAPHY AND LAND USE

The EMF study area includes portions of the cities of Pocatello and Chubbuck, unincorporated areas of Bannock and Power counties, the Fort Hall Indian Reservation, and U.S. Bureau of Land Management lands. Land use in the study area includes areas zoned for agriculture and various urban land uses, including residential, commercial, and industrial. Future land uses are not expected to change significantly from current uses. Future zoning of the EMF facilities and surrounding area is also not expected to change from present zoning. Population projections for the study area do not show significant changes from estimates of the current population.

This section identifies and characterizes human populations and general occurrences of livestock and food crops in the EMF study area. Demographics of the study area are presented in Section 3.6.1. Current and expected land uses are discussed in Section 3.6.2. Section 3.6.3 provides information on potential receptors. An overview of Section 3.6 is provided on Figure 3.6-1.

3.6.1 DEMOGRAPHICS

The EMF study area includes portions of the cities of Pocatello and Chubbuck. The 1990 populations of Pocatello and Chubbuck were estimated at 46,080 and 7,791, respectively (U.S. Department of Commerce, 1991). Population projections for Pocatello by the Northern Bannock County Metropolitan Planning Department (data files) for 1995 and 2000 are 48,946 and 52,197, respectively, indicating a slight growth trend for the city. No data are available for future growth for Chubbuck.

In 1990, approximately 30 percent of the population of Pocatello was under the age of 18, and about 11 percent over the age of 65. Statistics for Chubbuck are not available (Smart, 1992). However, the demographics of this community are most likely similar to those of neighboring Pocatello.

Unincorporated areas in Bannock and Power counties are used principally for agriculture. However, scattered residences (mainly isolated farmhouses) do occur in the unincorporated areas, along with one small subdivision (Section 3.6.2.1). Population statistics are not available for these unincorporated areas.

DEMOGRAPHY (SECTION 3.6.1):	• 1990 populations for Pocatello and Chubbuck were estimated at 46,080 and 7,791, respectively. Only slight growth is projected for Pocatello.
LAND USE (SECTION 3.6.2):	• Land uses in the area include the Fort Hall Indian Reservation, BLM, agricultural, residential, commercial and industrial areas, and special-use districts (Figure 3.6-2). • Minimal changes are expected in land use in the study area in the future (Figure 3.6-4).
POTENTIAL RECEPTORS (SECTION 3.6.3):	• Potential receptors include human populations in residential areas in the study area. Residents may grow fruits and vegetables. Beef cattle are kept at eight known residential properties. • Some livestock and two fish farms on the Portneuf River are located in the study area.

FIGURE 3.6-1
OVERVIEW OF DEMOGRAPHY AND LAND USE

3.6.2 LAND USE

Current and expected future land use in the EMF study area is described in this section. Land is used in the EMF study area for agricultural, residential, and industrial purposes, with little change expected in the future.

3.6.2.1 Current Land Use

The EMF study area includes portions of four jurisdictions: Fort Hall Indian Reservation, Bannock and Power counties, and BLM lands. Portions of both Pocatello and Chubbuck are also in the EMF study area.

Current land use zoning for Chubbuck, Pocatello, and the four jurisdictions is shown in Figure 3.6-2. This information is based on city and county zoning maps. Aerial photographs and visual reconnaissance were used to confirm actual land uses. Estimated acreages and percentages of total land use for the area depicted in Figure 3.6-2 within a three-mile radius of the EMF facilities are summarized in Table 3.6-1.

Land in the portions of Pocatello and Chubbuck in the EMF study area is primarily zoned for residential use. The closest area to the EMF facilities that is zoned for residential use is a little more than 1 mile (1.6 km) east of the Simplot facility, in Pocatello. This residential area is surrounded by various industrial, agricultural, and small commercial areas. Another residential area lies approximately 2 miles (3.2 km) northeast of the EMF facilities, in Chubbuck (Figure 3.6-2). Residences in the EMF Study Area are depicted on Figure 3.6-3.

Figure 3.6-2a illustrates land uses as categorized by the Shoshone-Bannock Tribes on the Fort Hall Reservation (Hanson, 1996). The majority of land use in the portion of the Reservation within the EMF site study area has been categorized by the Tribes as irrigated and dryland farming land. Other parts of the study area have been categorized as grazing areas and industrial areas (i.e., the FMC plant and the Pocatello municipal airport).

Fee lands are properties that have passed into the private ownership of individuals or corporations. The portion of the FMC facility that is located within the boundaries of the Fort Hall Reservation is on fee land. The Simplot facility is located outside the Fort Hall Reservation. The United States Supreme Court has determined that counties have zoning authority over fee lands in open areas of Indian reservations. However, the Shoshone-Bannock Tribes assert jurisdiction over fee lands within the Fort Hall Reservation. The matter of jurisdiction with respect to land use regulation is currently being litigated in *Shoshone-Bannock Tribes vs. FMC Corporation No. C-95-67.*

Trust lands on the Fort Hall Reservation, which are lands owned by the United States in trust for the Shoshone-Bannock Tribes or lands owned by tribal members subject to a trust restriction, are reported to be used by the tribal membership for cultural resources, hunting grounds, fishing, plant gathering for medicinal purposes, and religious and ceremonial activities.

The Pocatello Municipal Airport, which is annexed to the City of Pocatello, lies west of the EMF facilities. The airport is governed by its own master plan and is zoned as a special use district. The annexed area is predominantly commercial. Both the FMC and Simplot facilities are zoned as industrial. The FMC facility employs approximately 560 personnel, and Simplot employs 460.

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Unincorporated land in Bannock and Power counties is mostly agricultural with scattered residences. A small area in the southeastern portion of the EMF study area between the Portneuf River and I-86 is zoned for industrial use. Gravel extraction operations also occur in the EMF study area.

The BLM land located immediately south of the EMF facilities is designated as multiple use and includes cattle grazing (Figure 3.6-2). Land use for the Fort Hall Indian Reservation within the EMF study area is mainly agricultural. The FMC facility is adjacent to and partially within the Fort Hall Indian Reservation.

A former residence and adjacent restaurant, the Pilot House Cafe, are located on FMC property across Highway 30 from the FMC facility. The residence has not been occupied since October 31, 1994. The restaurant's lease was terminated on May 1, 1995.

Bannock Paving Company and Idaho Grain have also leased FMC property. Bannock Paving's lease terminated on March 12, 1995. Idaho Grain's lease was terminated on July 1, 1995.

3.6.2.2 Future Land Use

Future land use information presented in this section is based primarily on comprehensive plans (which are long-term planning documents) obtained from the offices of Chubbuck and Pocatello, and Bannock and Power counties, in addition to personal communications.

Future land use patterns projected for the EMF study area are shown in Figure 3.6-4. A comparison of this figure with Figure 3.6-2 shows that minimal changes to land-use designations in this area are expected in the future. Upon final closure of the FMC facility, FMC will record a notation on the deed to the facility property that will in perpetuity notify any potential purchaser of the property that the land use is restricted under 40 CFR 265, Subpart G, pursuant to RCRA.

No significant changes to land use designations are expected for the portions of Chubbuck, Pocatello, the unincorporated areas of Power County, and the BLM area located in the EMF study area. The area occupied by the Pocatello Municipal Airport is expected to continue to be zoned as a special use district. Similarly, there are no current plans for redesignating the FMC and Simplot facilities (zoned as industrial), or for county zoning amendments to land uses within a 1-mile (1.6-km) radius of these facilities.

The unincorporated area of Bannock County in the study area is zoned for development district multiple use (Figure 3.6-4), signifying the potential for changes to land use in the future. New uses in this district are screened for compatibility with existing uses to limit possible negative impacts (Feldberg, 1993).

The Shoshone-Bannock tribe is considering designating land southwest of I-86 to Michaud Creek as light industrial. Presently, this land, which is part of the Fort Hall Indian Reservation, is designated for agricultural uses. No plans have been finalized (Fenwick, 1993b).

3.6.3 POTENTIAL RECEPTORS

In the characterization of land use in the EMF study area, potential receptors which could be inadvertently exposed to EMF-related constituents were generally noted during field reconnaissance, and are discussed in Sections 3.6.3.2 to 3.6.3.4. Section 3.6.3.1 identifies area conditions that influenced the identification of potential receptors.

3.6.3.1 Site Conditions

Surface water recreational use in the lower reach of the Portneuf River is limited because of restricted public access. The Idaho Fish and Game Department began a rainbow trout stocking program in 1992. Approximately 500 to 1,000 catchable trout, 10 to 12 inches (25-30 cm) in size, were released upstream of the Rowland dairy (located 1 mile [1.6 km] north of the EMF facilities near the Portneuf River) for recreational fishing (Mende, 1992). Other recreational uses such as boating are restricted by limited public access. In addition, periodic public health warnings are issued, advising avoidance of contact recreational activities in the Portneuf River because of E. coli contamination resulting from unauthorized discharges in the City of Pocatello upstream from the EMF facilities (Low, 1993).

Batiste Spring water was formerly used by UPRR as a source of cooling water and potable water at its yard facility in Pocatello. The UPRR is currently using City-supplied water.

Irrigation canals (laterals) traverse agricultural lands in the counties; of these, only the Taghee Canal (Figure 1.3-1) passes through the EMF study area. Groundwater wells in the EMF study area, registered as of 1992 with the Idaho State Water Resources Department, are shown in Figure 3.6-5. These wells may be used for potable uses, livestock, or irrigation purposes. Table 3.6-2 lists location, ownership, and total diversion (i.e., allowed withdrawal) of these wells. Since this list was taken from the public record without independent verification, the information contained therein may have errors.

3.6.3.2 Human Populations

This section identifies the locations of schools, day-care facilities, hospitals, and nursing homes. These facilities are identified in Figure 3.6-6.

Two schools are located in the EMF study area in the City of Pocatello: Wilcox Elementary School and Hawthorne Junior High School. Six licensed day-care centers are also present in the study area. The Idaho State Air Craft Mechanics school, which admits students from 16 years of age and older, is located at the Pocatello airport.

One elementary school (Chubbuck Elementary School) and one retirement home (Cottonwood Cove Retirement Community) are located within a residential area of the City of Chubbuck.

There are no hospitals or nursing homes in the EMF study area. The entire Pocatello/Chubbuck region, including areas outside the study area, has 28 private and public schools (five private and 23 public), five senior living/nursing homes, two hospitals, and 73 licensed day-care centers.

3.6.3.3 Livestock and Food Crops

No dairy farms operate in the EMF study area (Pattern, 1992). The Rowland creamery is located about 1 mile (1.6 km) north of the EMF facilities near the Portneuf River. Milk products are processed at the creamery, but no herd is kept in the EMF study area.

Based on information from the University of Idaho Cooperative Extension Agent, there are eight residential properties (farms) surrounding the EMF facilities, where there exist 32 head of cattle (Gardener, 1994). None of these cattle are used for dairy purposes. Four residents with beef cattle keep them twelve months out of the year. The other residents keep their cattle eight months out of the year after which time they either sell them or have the cattle slaughtered for their own use. During these months, the cattle are allowed to graze on pastures consisting of sagebrush, quack grass, smooth brome, and intermediate grass. Also during this time, especially after the first five months, the cattle feed is typically supplemented with hay and grain from other areas. It is estimated that during this later period, 50 percent of food utilized by the cattle is secured from grazing and 50 percent is secured from hay and grain shipped in from outside the study area. The beef breeding stock are not slaughtered; they are used to produce calves that are sold as feeder animals after eight to twelve months.

In addition to agricultural areas (Figure 3.6-2) used primarily to grow potatoes, grain, alfalfa, and wheat crops, individual residents may also maintain home gardens. Based on information from the extension agent and local gardening centers, the major types of homegrown vegetables include tomatoes, peas, beans, corn, carrots, cucumbers, eggplants, broccoli, cabbage and turnips. The major homegrown fruits include strawberries, raspberries, and plums. Most gardens are, however, a diverse mixture, with ornamental plants predominating in the gardens of wealthier areas and vegetable production being largely restricted to lower income families and communities (Chase, 1994). Vegetable gardens produce about one-fifth of the fruit and vegetable intake of residents who garden (Gardener, 1994). These estimates are lower than those provided by EPA (RAGS, 1991), but are consistent with the lower than average productivity of this region (due to the short growing season and stressful climate conditions) compared to other agricultural areas of the U.S. (Baes et al., 1994).

Two commercial fish farms, the Papoose Springs and Batiste Springs fish farms, are located on the Portneuf River in the EMF study area. Fish raised at these facilities are sold both for stocking streams and human consumption.

3.6.3.4 Human Use of, or Access to, the Properties and Adjacent Areas

Both the FMC and Simplot facilities are operating plants and have controlled access. Both facilities have implemented programs for worker safety that comply with or exceed Federal Occupational Safety and Health Administration requirements (as codified in applicable portions of 29 CFR 1910 and 1920).

Areas adjacent to the EMF facilities are subject to varying land uses, as discussed in Section 3.6.2.

Surface and Subsurface Characterizations
Tables for Section 3.6

TABLE 3.6-1
EMF STUDY AREA LAND USES AND AREAS

Land Use	Area		Percentage
	Acres	Hectares	
Agricultural	1,047	424	6
Residential	1,853	750	10
Commercial	93	38	0.5
Industrial	2,909	1,177	16
Special Use District	2,615	1,058	14.5
Unzoned	485	193	3
Fort Hall Indian Reservation: Agricultural	6,743	2,729	37
U.S. Bureau of Land Management: Multiple	2,337	946	13
Total	18,082	7,315	100

Sources: Acreage calculations derived from Figure 3.6-2, "Current Land Use" for areas within a three-mile radius of the EMF facilities.

TABLE 3.6-2
WELL REGISTRATION TABLE

TRACT	OWNER	TOTAL DIVERSION (CUBIC FEET PER SECOND)
Township: 05S Range: 33E Section: 36		
NENE	(b) (6) [redacted]	0.04
NWNENE	[redacted]	0.04
SENE	[redacted]	0.06
Township: 05S Range: 34E Section: 31		
SENESE	(b) (6) [redacted]	0.04
SWSE	[redacted]	0.06
SWSE	[redacted]	0.04
SWSE	[redacted]	0.04
NESWSE	[redacted]	0.08
NENENE	[redacted]	0.06
SESENE	[redacted]	0.04
NENW	[redacted]	0.08
NWNWNW	[redacted]	0.04
Township: 05S Range: 34E Section: 32		
SWNWNW	(b) (6) [redacted]	0.13
SWNW	[redacted]	0.04
SWNW	[redacted]	0.04
SWNW	[redacted]	0.04
NESWNW	[redacted]	0.25
NWSWNW	[redacted]	0.06
NWSWNW	[redacted]	0.06
SENW	[redacted]	0.04
SENW	[redacted]	0.24
SWSENW	[redacted]	0.04
SWSENW	[redacted]	0.04
SWSENW	[redacted]	0.04
SWSENW	[redacted]	0.04
SWSENW	[redacted]	0.04
NENWSE	Church of Jesus Christ, Latter Day Saints	0.24
SWSE	(b) (6) [redacted]	0.04

TABLE 3.6-2 *(continued)*
WELL REGISTRATION TABLE

TRACT	OWNER	TOTAL DIVERSION (CUBIC FEET PER SECOND)
Township: 05S Range: 34E Section: 32 (Continued)		
SWSE	(b) (6) [redacted]	0.06
SWSE	[redacted]	0.06
SESWSE	[redacted]	0.04
SESWSE	[redacted]	0.03
SESESE	[redacted]	0.04
Township: 05S Range: 34E Section: 33		
NENENE	(b) (6) [redacted]	0.06
SESENE	[redacted]	0.04
SESENE	[redacted]	0.04
SWNWSW	[redacted]	0.04
SESW	[redacted]	0.04
SESESW	[redacted]	0.04
NESE	[redacted]	0.08
Township: 06S Range: 33E Section: 01		
NENE	Monric Inc.	4.46
SWNENE	Thousand Springs	75.14
SWNENE	Aqua Life Inc.	75.00
SWNENE	Aqua Life Inc.	0.14
SWNWNE	Thousand Spings	75.14
SWNWNE	Aqua Life Inc.	75.00
NWSENE	Aqua Life Inc.	0.10
NWSENE	Thousand Spings	75.14
NWSENE	Aqua Life Inc.	75.00
NENENW	(b) (6) [redacted]	0.04
SWSESW	[redacted]	3.60
SWSESW	[redacted]	3.60
SWNESE	[redacted]	1.18
SENESE	[redacted]	0.66

TABLE 3.6-2 *(continued)*
WELL REGISTRATION TABLE

TRACT	OWNER	TOTAL DIVERSION (CUBIC FEET PER SECOND)
Township: 06S Range: 33E Section: 02		
NENE	(b) (6) [redacted]	0.04
NWNENE	[redacted]	0.04
NWNENE	[redacted]	0.08
SENWNE	[redacted]	0.04
SWSENE	[redacted]	0.06
NENW	[redacted]	0.24
NENENW	[redacted]	0.18
SWNENW	[redacted]	0.12
NWNW	[redacted]	0.20
NENWNW	[redacted]	0.09
NENWNW-1	[redacted]	0.06
NENWNW	[redacted]	0.06
NENWNW-2	[redacted]	0.03
SENW	[redacted]	0.18
NESE	[redacted]	0.04
NESE	[redacted]	0.04
SESESE	[redacted]	0.06
Township: 06S Range: 33E Section: 04		
SENWNE-1	(b) (6) [redacted]	0.63
SENWNE-2	[redacted]	0.10
SENWNE-1	[redacted]	1.23
SENWNE	[redacted]	0.63
SENWNE-2	[redacted]	0.13
Township: 06S Range: 33E Section: 10		
NESE-1	City of Pocatello	3.34
NESE-2	City of Pocatello	1.92
Township: 06S Range: 33E Section: 11		
NWSE-1	(b) (6) [redacted]	2.60
NWSE-2	[redacted]	0.38

TABLE 3.6-2 *(continued)*
WELL REGISTRATION TABLE

TRACT	OWNER	TOTAL DIVERSION (CUBIC FEET PER SECOND)
Township: 06S Range: 33E Section: 12		
SENE	City of Pocatello	5.72
NWSWNW	(b) (6)	1.49
NWNWSW-1		0.40
NWNWSW-2		0.48
SESWSW-1	FMC Corporation	0.63
SESWSW-2	FMC Corporation	0.04
SESW	FMC Corporation	4.50
NESE	FMC Corporation	1.10
Township: 06S Range: 33E Section: 13		
NENW	FMC Coporation	4.00
NWNW	FMC Coporation	4.50
Township: 06S Range: 33E Section: 14		
SESE	Idaho Power Co.	0.02
Township: 06S Range: 33E Section: 15		
SWNE	City of Pocatello	2.20
SWNE	(b) (6)	2.20
Township: 06S Range: 33E Section: 22		
NWNW		4.78
SWSW	Michaud Creek	2.00
SWSW	Michaud Creek	1.08
NESE-1	(b) (6)	0.04
NESE-2		0.04
NESE		0.20
NWNESE		0.20
NWNESE		0.12
NWNESE		0.04
NWNESE		0.06
NWNESE		0.16
NENWSE		0.04
NWNWSE		0.04
SESE		0.04
SESE		0.04
NWSESE		0.04

TABLE 3.6-2 *(continued)*
WELL REGISTRATION TABLE

TRACT	OWNER	TOTAL DIVERSION (CUBIC FEET PER SECOND)
Township: 06S Range: 33E Section: 23		
SWSW-1	(b) (6)	0.26
SWSW-2	[redacted]	0.26
Township: 06S Range: 34E Section: 04		
NENENE	(b) (6)	0.04
NENENE	[redacted]	0.04
NENENE	[redacted]	0.04
NENENE	[redacted]	0.04
SENE	[redacted]	0.06
NWNW	Church of Jesus Christ, Latter Day Saints	0.15
NWSWNW	(b) (6)	0.14
NWSW	[redacted]	0.04
NWSW	[redacted]	0.04
NWSW	[redacted]	0.06
SWNWSW	[redacted]	0.06
SWSWSW	[redacted]	0.06
SESW	City of Chubbuck	4.45
NESE	(b) (6)	0.06
SESWSE	[redacted]	0.06
Township: 06S Range: 34E Section: 05		
NENE	(b) (6)	0.02
NENE	[redacted]	0.08
NENE	[redacted]	0.06
NENE	[redacted]	0.05
NENENE	[redacted]	0.16
NENENE	[redacted]	0.06
SENENE	[redacted]	0.07
NWNE	[redacted]	0.06
SWNWNE	[redacted]	0.04
SWNWNE	[redacted]	0.04
SWNWNE	[redacted]	0.06
SWNE	[redacted]	0.06

TABLE 3.6-2 ***(continued)***
WELL REGISTRATION TABLE

TRACT	OWNER	TOTAL DIVERSION (CUBIC FEET PER SECOND)
Township: 06S Range: 34E Section: 05 (Continued)		
SWNE	(b) (6)	0.04
NWSWNE	[redacted]	0.04
SESWNE	[redacted]	0.04
NESENE	[redacted]	0.08
NWSENE	[redacted]	0.04
NENW	[redacted]	0.04
NENW	[redacted]	0.04
SENW	[redacted]	0.04
SENW	[redacted]	0.04
NWSW	[redacted]	0.09
NWSW	[redacted]	0.16
SWNWSW	[redacted]	0.04
SWSW	[redacted]	0.04
SWSW	[redacted]	0.04
SWSW	[redacted]	0.04
SWSW	[redacted]	0.04
NWSWSW	[redacted]	0.06
SESW	[redacted]	0.08
SESW	[redacted]	0.04
SESW	[redacted]	0.04
SESW	[redacted]	0.04
SESW	[redacted]	0.03
SESW	[redacted]	0.06
SESW	[redacted]	0.04
SESW	[redacted]	0.06
SESW	[redacted]	0.04
NWSESW	[redacted]	0.04
SWSESW	[redacted]	0.04
SESESW	[redacted]	0.06
SESWSE	[redacted]	0.24

TABLE 3.6-2 *(continued)*
WELL REGISTRATION TABLE

TRACT	OWNER	TOTAL DIVERSION (CUBIC FEET PER SECOND)
Township: 06S Range: 34E Section: 06		
NESW	FMC	0.09
NWNWSW	(b) (6)	0.17
SWNWSW	[redacted]	0.04
SWNWSW	[redacted]	0.25
SWNWSW	[redacted]	0.04
SENWSW	[redacted]	0.04
NWSESW	Aqua Life Inc.	0.04
SESESW	Aqua Life Inc.	44.77
NESE	(b) (6)	0.06
SENE	[redacted]	0.04
SENE	Jackson Inc.	0.08
NENENW	(b) (6)	0.14
SWSWNW	[redacted]	0.63
SESWNW	Thousand Springs	75.14
SESWNW	Aqua Life Inc.	75.00
SENW	Monroc Inc.	4.46
Township: 06S Range: 34E Section: 07		
NENE	City of Pocatello	12.13
NWNE	(b) (6)	0.02
NWNE	[redacted]	0.56
SENWNE	Rowlands, Inc.	0.30
SWNE	City of Pocatello	9.28
SWNE	Union Pacific	1.48
NWNW	Chevron	1.00
NWNW	Chevron	0.56
NESW	J.R. Simplot	6.68
NESW-1	J.R. Simplot	5.57
NESW-2	J.R. Simplot	6.66
NESW	J.R. Simplot	0.10
SESW	J.R. Simplot	0.10
SESW	J.R. Simplot	6.68
SESW-1	J.R. Simplot	5.57

TABLE 3.6-2 *(continued)*
WELL REGISTRATION TABLE

TRACT	OWNER	TOTAL DIVERSION (CUBIC FEET PER SECOND)
Township: 06S Range: 34E Section: 07 (Continued)		
SESW-2	J.R. Simplot	6.66
NESE	J.R. Simplot	3:20
NESE	J.R. Simplot	0.22
NESE	J.R. Simplot	2.28
NWSE	J.R. Simplot	0.28
NWSE	J.R. Simplot	3.35
Township: 06S Range: 34E Section: 08		
NENE	(b) (6) [redacted]	0.06
NWNE	[redacted]	0.08
NWNE	[redacted]	0.07
NWNE	[redacted]	0.04
NWNE	[redacted]	0.09
NWNWNE	[redacted]	0.04
NENW	[redacted]	0.04
NENW	[redacted]	0.04
NENW	[redacted]	0.06
NENW	[redacted]	0.04
NENW	[redacted]	0.02
NENW	[redacted]	0.18
NENW	[redacted]	0.06
NENW	[redacted]	0.06
NENW	[redacted]	0.06
NENENW	[redacted]	0.06
NENENW	[redacted]	0.06
NENENW	[redacted]	0.06
NWNW	[redacted]	0.06
SENW	J.R. Simplot	0.15
SENW	J.R. Simplot	0.15
SWSE	(b) (6) [redacted]	0.04

TABLE 3.6-2 *(continued)*
WELL REGISTRATION TABLE

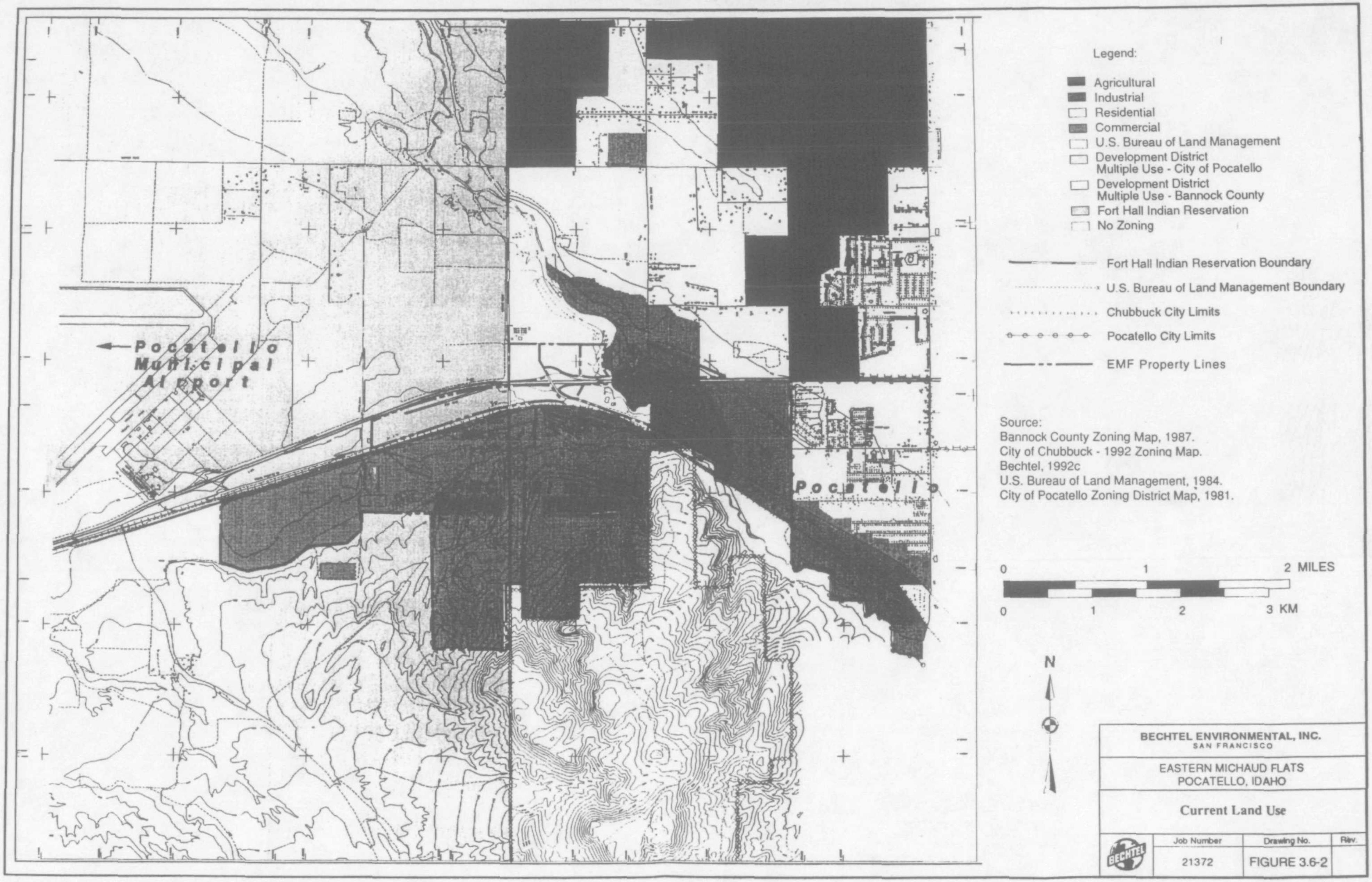
TRACT	OWNER	TOTAL DIVERSION (CUBIC FEET PER SECOND)
Township: 06S Range: 34E Section: 09		
SWSWNW	(b) (6)	0.06
NESE	[redacted]	0.04
NESE	[redacted]	0.09
NESE	[redacted]	0.06
SENESE	[redacted]	0.04
SWSE	[redacted]	1.00
SESE	[redacted]	0.02
SWSESE	[redacted]	0.06
SWSESE	[redacted]	0.06
Township: 06S Range: 34E Section: 10		
NENE	City of Pocatello	17.07
NENE	(b) (6)	0.02
NWNE	[redacted]	0.08
SWSENE	[redacted]	0.06
SWSENE	[redacted]	0.04
SWNW	[redacted]	0.06
NWSWNW	[redacted]	0.08
SENW	[redacted]	0.10
NWSENW	[redacted]	0.04
NWSENW	[redacted]	0.04
SESW	[redacted]	0.38
SESW	Great Western	3.25
Township: 06S Range: 34E Section: 16		
SESW	J.R. Simplot	3.20
SESW	J.R. Simplot	2.28
Township: 06S Range: 34E Section: 17		
SWNE	(b) (6)	0.06
NESENE	Pocatello Read	0.24

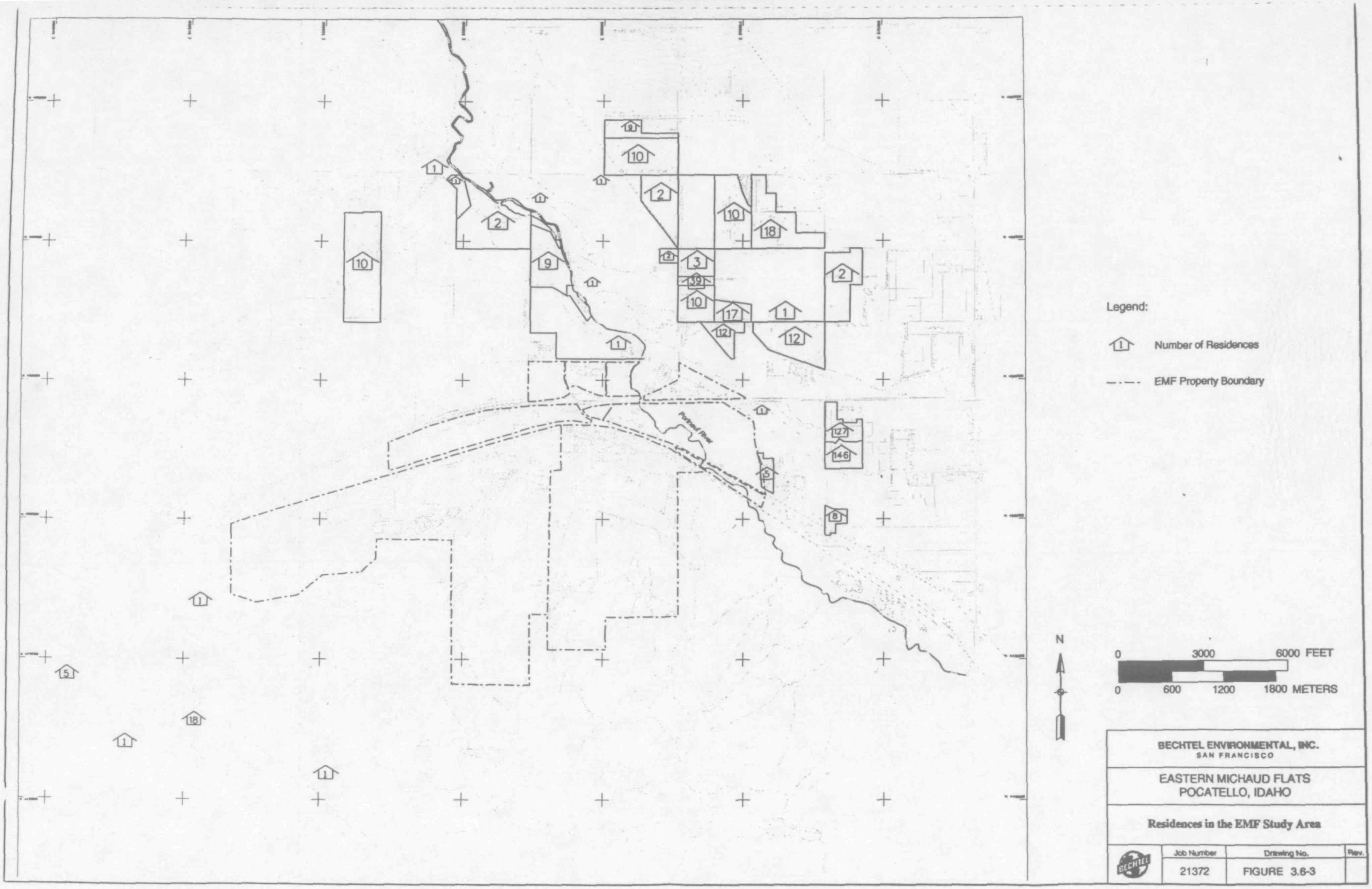
TABLE 3.6-2 ***(continued)***
WELL REGISTRATION TABLE

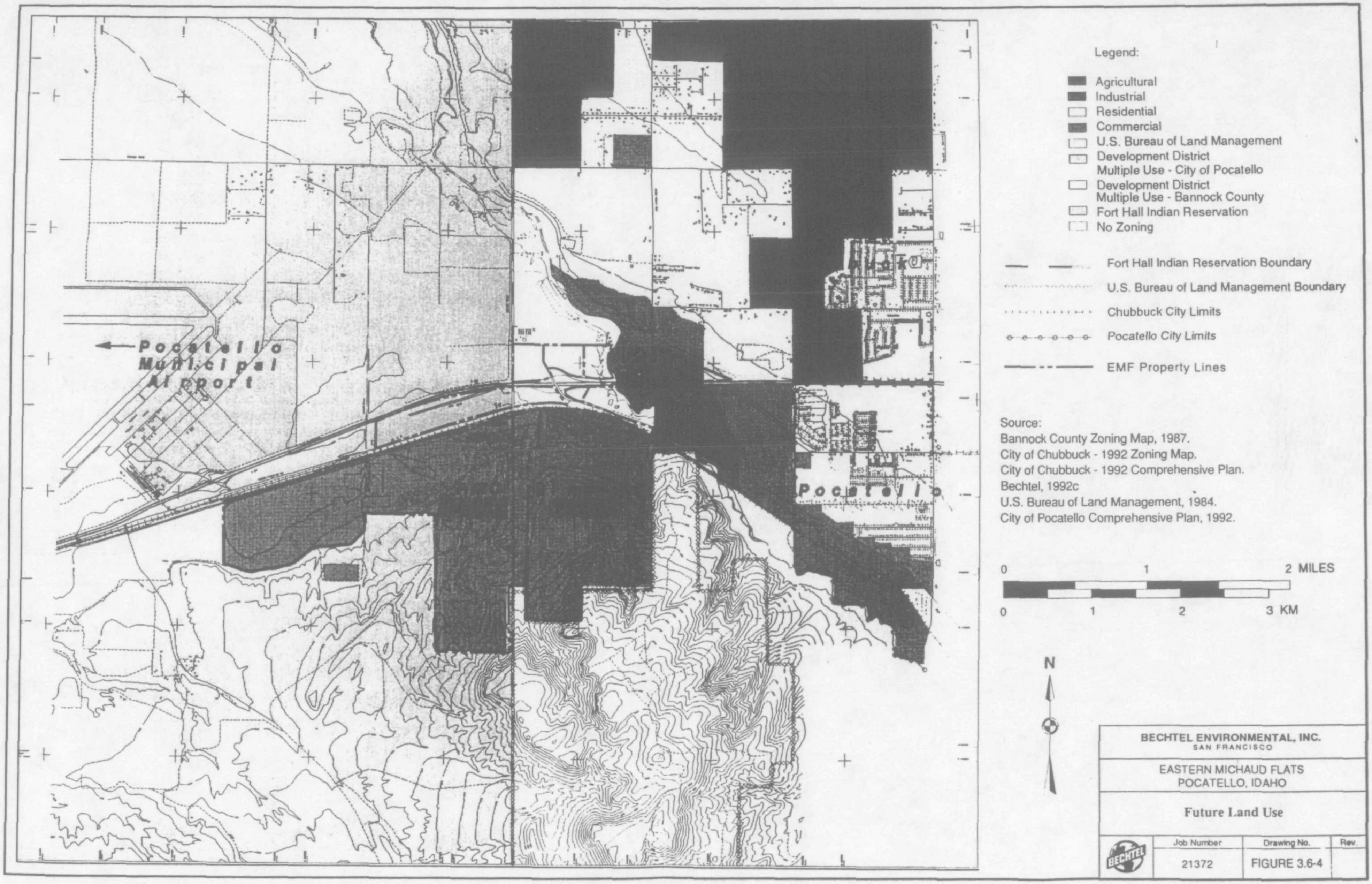
TRACT	OWNER	TOTAL DIVERSION (CUBIC FEET PER SECOND)
Township: 05S Range: 34E Section: 31		
NENE	(b) (6) [redacted]	0.04
NENE	[redacted]	0.11
NENENE	[redacted]	0.06
NWNE	[redacted]	0.11
NENW	[redacted]	0.11
NWNW	[redacted]	0.04
SWNW	[redacted]	0.06
SWSWNW	[redacted]	0.04
SWSWNW	[redacted]	0.04

Source: Idaho Department of Water Resources, 1992 data files.

Surface and Subsurface Characterizations
Figures for Section 3.6

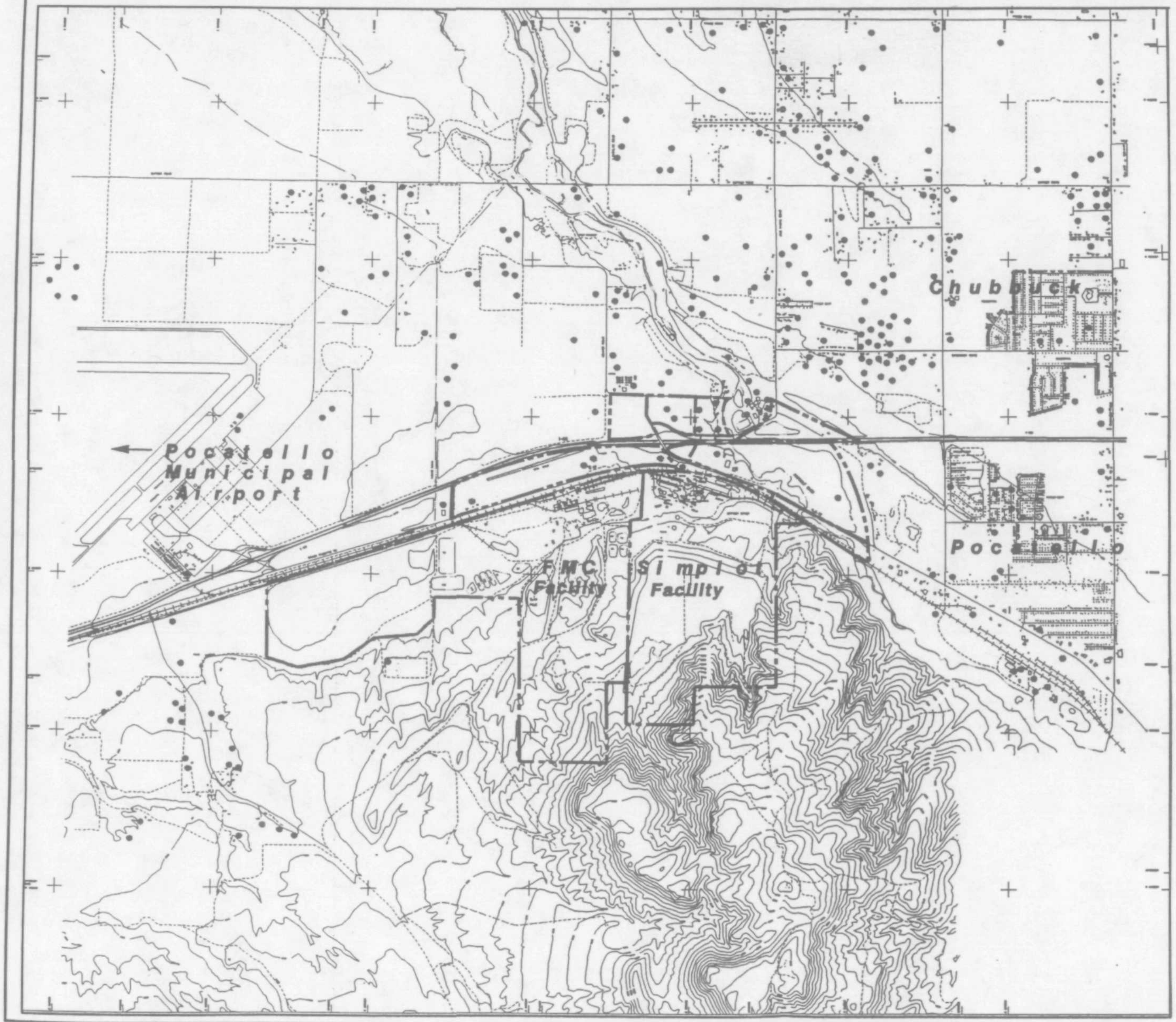

Pocatello Municipal Airport
Pocatello
Legend:
Agricultural
Industrial
Residential
Commercial
U.S. Bureau of Land Management
Development District Multiple Use - City of Pocatello
Development District Multiple Use - Bannock County
Fort Hall Indian Reservation
No Zoning
Fort Hall Indian Reservation Boundary
U.S. Bureau of Land Management Boundary
Chubbuck City Limits
Pocatello City Limits
EMF Property Lines
Source:
Bannock County Zoning Map, 1987.
City of Chubbuck - 1992 Zoning Map.
Bechtel, 1992c
U.S. Bureau of Land Management, 1984.
City of Pocatello Zoning District Map, 1981.
0 1 2 MILES
0 1 2 3 KM
N
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Current Land Use
Job Number
21372
Drawing No.
FIGURE 3.6-2
Rev.
BECHTEL


Portneuf River
Legend:
Number of Residences
EMF Property Boundary
N
0 3000 6000 FEET
0 600 1200 1800 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Residences in the EMF Study Area
Job Number
21372
Drawing No.
FIGURE 3.6-3
Rev.



Source:
Bannock County Zoning Map, 1987.
City of Chubbuck - 1992 Zoning Map.
City of Chubbuck - 1992 Comprehensive Plan.
Bechtel, 1992c
U.S. Bureau of Land Management, 1984.
City of Pocatello Comprehensive Plan, 1992.

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Future Land Use		
Job Number	Drawing No.	Rev.
21372	FIGURE 3.6-4	



Legend:

● Groundwater well location. Wells may be used for drinking, livestock, or irrigation.

EMF Property Lines

Note:

See Figure 2.4-1 for well location within FMC and Simplot Facility Boundary.

Source: Idaho Department of Water Resources data files, 1992.

0 1 2 MILES

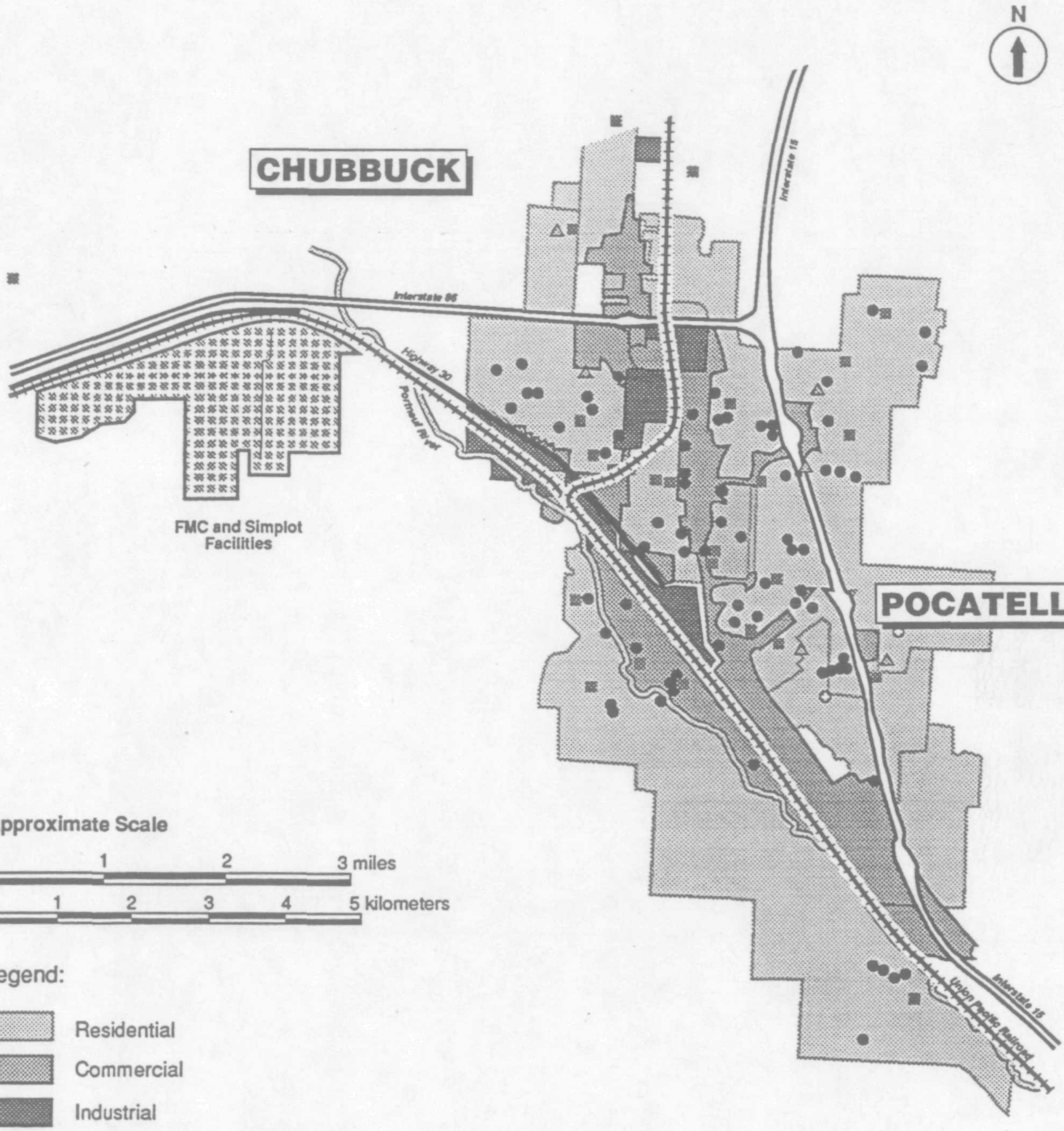
0 1 2 3 KM

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Wells in the EMF Study Area

Job Number	Drawing No.	Rev.
21372	FIGURE 3.6-5	



Approximate Scale

0 1 2 3 miles

0 1 2 3 4 5 kilometers

Legend:

- Residential
- Commercial
- Industrial
- EMF Facilities
- ● Licensed Day Care Facilities
- ■ Public and Industrial/Technical Schools
- △ Nursing Homes / Senior Living
- ○ Hospitals

Source: *City of Pocatello / City of Chubbuck Zoning District Maps – April 1990*

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
EASTERN MICHAUD FLATS POCATELLO, IDAHO			
Sensitive Receptors General Locations			
BECHTEL	JOB No. 21372	DRAWING NO. FIGURE 3.6-6	REV.

93-1477b.066 lw/ :5

3.7 ECOLOGICAL CHARACTERIZATION

The ecological characterization described below provides a context in which to place the biological resources in the EMF study area. A summary of the terrestrial and aquatic ecosystems presented in this section focuses on important habitats and species occurring or potentially occurring in the study area. Section 3.7.1 describes important habitats and species in the terrestrial ecosystem, as well as the potential occurrence of federal and state protected species. Section 3.7.2 describes the aquatic ecosystem of the Portneuf River (the portion of the river that is in the EMF study area), and includes discussions on important habitats and sensitive species. An overview of this section is presented in Figure 3.7-1.

3.7.1 TERRESTRIAL ECOSYSTEMS

Major terrestrial vegetation cover types and wildlife habitats in the EMF study area include–in order of areal extent–agriculture, sagebrush steppe, and wetland/riparian. The remainder of the study area is in residential, industrial, and commercial development. The EMF facilities were originally in sagebrush steppe but are now largely disturbed and provide limited wildlife habitat. The Portneuf River is the major aquatic ecosystem in the EMF study area although the water quality is affected by anthropogenic influences from various sources along the Portneuf River within the city limits of Pocatello. No critical habitat of threatened or endangered plant or animal species is known to occur in the EMF facilities area.

Sensitive wildlife species (defined as species provided federal protection such as threatened or endangered species, migratory waterfowl, raptors [birds of prey], or, candidates for listing as threatened or endangered or species directly in the human food chain) known to occur in the study area include waterfowl (ducks and geese), white-tailed deer and mule deer, and upland game birds. Bald eagles may occasionally use habitats along the Portneuf River for hunting, and peregrine falcons are known to migrate through the study area. Several species of raptors also hunt and nest in the study area. Golden eagles have been observed nesting in undisturbed cliff habitat on the southern edge of the EMF facilities area.

TERRESTRIAL ECOSYSTEMS (SECTION 3.7.1):	• Major terrestrial vegetation cover types and wildlife habitats in the EMF study area include agriculture, sagebrush steppe, and wetland/riparian, as shown in Figure 3.7-2. • Wildlife habitats in the vicinity of the EMF facilities include: sagebrush steppe, grassland, riparian, cliff, and juniper woodland. • No critical habitats for threatened or endangered species, or special habitats, occur in the study area.
AQUATIC ECOSYSTEMS *(SECTION 3.7.2):*	• The most significant aquatic habitats in the immediate vicinity of the EMF facilities are the Portneuf River and associated springs. The Portneuf River flows to the American Falls Reservoir. River water quality is reduced by numerous point and nonpoint sources discharging to the river above and below the EMF facilities. • Sightings of several endangered or threatened species, or candidate species have been reported in the Fort Hall Bottoms. • A number of important aquatic species and habitats are present in the study area (Section 3.7.2.3).

FIGURE 3.7-1
OVERVIEW OF ECOLOGICAL CHARACTERIZATION

3.7.1.1 Vegetation Cover Types and Wildlife Habitats

The EMF facilities are approximately 5 miles (8 km) southeast of the American Falls Reservoir, part of the Minidoka Wildlife Refuge System, and about 4 miles (6.4 km) south of the riparian/wetland-dominated floodplains at the mouths of the Portneuf and Snake Rivers (Fort Hall Bottoms). At higher elevations, 5,000 feet (1,524 m) to the south and west of the EMF facilities, Utah juniper woodland dominates the Bannock Range with pockets of aspen (*Populus tremuloides*), snowberry (*Symphoricarpus sp.*), and mountain mahogany (*Cerocarpus montanus*) in the draws. Sagebrush steppe occurs at lower elevations extending to the American Falls Reservoir.

The EMF study area includes urban (Chubbuck and Pocatello) and agricultural areas, as well as rangeland within the Fort Hall Indian Reservation and BLM lands. Major vegetation cover and wildlife habitat types existing in the study area include sagebrush steppe, riparian/wetlands, agriculture, and disturbed/urban areas. In addition, cliffs to the south of the EMF facilities provide cliff/cave habitats for some wildlife species, as described later in this section. Figure 3.7-2 shows the geographical distribution of the major vegetation cover types and associated wildlife habitats identified in the EMF study area, and Table 3.7-1 shows the total associated acreages. The vegetation and habitats are described briefly below.

Sagebrush Steppe

Sagebrush steppe vegetation occurs at elevations below 6,622 feet (2,019 m) on the Bannock Mountains to the anthropogenically undisturbed alluvial plain of the Portneuf River. This vegetation type covers 34 percent (6,139 acres/2,485 ha) of the area within a three-mile radius of the facilities. In addition, most of the Fort Hall Indian Reservation portion of the study area is in this vegetation type. Species of this vegetation type include big sagebrush (*Artemisia tridentata*), rabbit brush (*Chrysothamnous nauseosus*), Antelope bitterbrush (*Purshia tridentata*), arrow leaf balsamroot, tapertip hawksbeard, and bunch grasses including bluebunch grass (*Agropyron spicatum*), western wheat grass (*Agropyron smithii*), Indian rice grass (*Oryzopsis *hymenoides*), needle-and-thread (*Stipa comata*), Idaho fescue (*Festuca idahoensis*), and squirreltail (*Sitanion hysterix*) (Cronquist et al., 1972). Other grasses include Nevada bluegrass, prairie junegrass, Sandberg bluegrass, and slender wheatgrass (SCS, 1987). The BLM land in the southern portion of the EMF study area and Fort Hall Indian Reservation lands to the south and west are in sagebrush steppe.

At elevations above 6,622 feet (2,019 m), and to the south of the FMC and Simplot facilities, Utah juniper (*Juniperus osteosperma*, a dominant of juniper woodland) intergrades along the sides of draws with the sagebrush-dominated slopes. Bitterbrush provides browse for mule deer (*Odocoileus hemionus*) in this area.

In addition to wildlife habitat, this vegetation type has continued to be used as rangeland for cattle grazing, both on the BLM land and Fort Hall Indian Reservation (Hogander, 1992).

Vertebrate species expected or observed in this habitat include shrews, sagebrush voles, deer mice, pocket mice, weasels, mule deer, hawks, owls, shrikes, kingbirds, sparrows, spadefoot toads, tiger salamander, and lizards. The population density of some species is expected to decrease with distance from the primary water source, the Portneuf River.

Riparian/Wetlands

Riparian/wetland vegetation in the EMF study area occurs along portions of Michaud Creek, the Portneuf River, and in association with springs and seeps, gravel and borrow areas, and irrigation canals. This vegetation type makes up 3 percent (597 acres/242 ha) of vegetation/habitats within a three-mile radius of the EMF facilities in the study area. Locations of wetlands and riparian habitats identified on U.S. Fish and Wildlife Service (U.S. FWS) wetland inventory maps (U.S. FWS, 1980) are shown in Figure 3.7-2.

Wetlands provide a variety of functions. Major categories of wetland functions (Sather and Smith, 1984) relating to key functions in the EMF study area include the following:

- Sediment entrapment — This is an important function because it removes pollutants and sediments from moving waters.
- Nutrient retention and removal — The nutrient retention and removal function of wetlands involves the uptake or storage and modification of nutrients, especially nitrogen and phosphorus, in vegetation or the substrate.
- Food chain support/nutrient export — Food chain support refers to the function of removing nutrients and making them available to autotrophic (plants) consumers and a variety of heterotrophic (animal) consumers.
- Fisheries habitat — Major factors influencing value of fisheries habitat include physical and chemical water quality and quantity including hydroperiod, flow and depth, and cover substrate and interspersion. Freshwater fisheries are primarily influenced by temperature and dissolved oxygen, with turbidity, alkalinity, and pH also being important. Cover refers to areas used by fish for protection from predators and climatic conditions, and substrate for feeding and reproduction. Interspersion refers to the relationship between open water and vegetation, types of vegetation, and various substrates.
- Wildlife habitat — Wildlife habitat value is based upon structure and species diversity of the vegetation, surrounding land uses, spatial patterns within and between wetlands, vertical and horizontal zonation, size, and water chemistry.
- Socioeconomic values — Socioeconomic values include those that provide direct and indirect social and economic benefits such as recreation, hunting, and aesthetics.
- Flood control — Factors affecting flood control include size, location within the drainage basin, texture of substrate, and lifeform of wetland vegetation.
- Shoreline anchoring — Factors influencing anchoring include type of vegetation that binds and stabilizes substrates and dissipates wave and current energy.
- Groundwater discharge and recharge — Factors affecting discharge and recharge are the nature of substrate, water permanence, the nature of surface outlets and amount of edge, type, and amount of vegetation.

- Disruption of erosive forces — Control of erosion depends upon vegetation, plant species involved, width of vegetated shoreline band, efficiency of vegetated band to soil composition, height and slope of bank, and elevation of the toe of the bank with respect to mean storm high water.

General evaluation of wetland functions and data collection during the Phase I fall (September 1992) reconnaissance focused on fisheries and wildlife habitats and socioeconomic values of hunting.

Michaud Creek. The portion of Michaud Creek in the EMF study area is intermittent, with riparian vegetation forming a corridor along the creek. Also, five wetland areas, as delineated on U.S. FWS wetland inventory maps (1980), occur along Michaud Creek (Figure 3.7-2). These include three riverine open water perennial wetlands, in Sections 22 and 23 (T6S, R33E), a palustrine (marshy) emergent, seasonally persistent excavated wetland in Section 15 (T6S, R33E), and a palustrine wetland associated with an impounded area on the creek in Section 22 (T6S, R33E).

During field reconnaissance, prevalent tree species found along the creek included peachleaf willows (*Salix lasidandra*), alder (*Alnus tenufolia*), and cottonwood (*Populus angustifolia*). At the lower reach near Taghee lateral, Siberean elm, an introduced species, also occurred. Understory shrub vegetation included coyote willow (*Salix exigua*), rose (*Rosa sp.*), red-osier dogwood (*Cornus stolonifera)*, chokecherry (*Prunnus virginnia*), and currant (*Ribes sp.*). Grasses and weedy species in the herbaceous layer included bluebunch wheatgrass, slender wheatgrass, bluegrass (*Poa palustris.*), cheatgrass (*Bromus tectorum*), annual sunflower (*Helianthus annulus*), Russian thistles (*Salsola kali*), and other species such as balsam root (*Balsamorhiza sogittata*) and lamb's-quarters (*Chenopodium alba*). Adjacent land use is cattle grazing. Cattle grazing also occurs in the riparian vegetation along the creek. Stresses on vegetation due to grazing effects, such as trampling of understory vegetation and soils, and compacted soils and grazing lines on trees and shrubs, were evident. No other stresses on vegetation were noted.

The riparian vegetation and isolated wetlands along the creek provide a wildlife habitat. Riparian vegetation along the creek is important to wildlife in the adjacent sagebrush steppe habitat; it serves as a food and water source, as well as provides cover. Palustrine wetland areas on the creek are mostly associated with man-made impoundments near livestock pens and farmhouses. Species found in these wetlands include cattails, willows, sedges, smartweed, and mint.

Portneuf River. The most important wetlands in the EMF study area occur along the Portneuf River, from the end of channelization in the City of Pocatello, through the Portneuf River floodplain on the Fort Hall Indian Reservation to the American Falls Reservoir. The wetlands along this portion of the river vary in width from an estimated few feet up to approximately 100 feet (30.5 m) in some areas. These wetlands provide habitat, food sources, and resting areas for a variety of wildlife species, such as beavers, ducks, geese, and waterbirds. They also probably provide some sediment trapping, nutrient retention, and cycling functions within the ecosystem. Sediment samples were collected in July and August 1992 at 24 sites along the river. Characterizations of these sites are contained in Section 3.7.2. An additional four sites were sampled in October 1992 downstream from river mile 10, and two additional sites between sampling points 23 and 22 upstream of the facility.

A variety of wetland and riparian vegetation occurs along the river, depending upon water and soil saturation conditions. The majority of these wetlands delineated by the U.S. FWS (1980) include riparian scrub shrub, and both deciduous and palustrine emergent vegetation.

The riparian vegetation along the river, including the riparian scrub shrub deciduous wetlands, is adapted to soil conditions that are saturated at least a portion of the year. This vegetation is well-developed and extends from the edges of the river to the drier uplands. The tree layer that occurs intermittently with an open canopy below Batiste Road is composed of peachleaf willow with a dense shrub understory. Shrub understory species are the most prevalent. The shrub understory is made up of coyote willows and other shrubs such as red-osier dogwood, rose, alder, currant, and chokecherry. Where the shrub layer is more open, grasses and herbaceous species occur including numerous grasses, such as bluegrass, bromes, and grasslike sedges, and dandelion (*Taraxacum offinale*). Above Batiste Road, the tree canopy is closed with mature peachleaf willows and alder up to 20 feet (6 m) high. The understory is dominated by grasses and herbs including bluegrass (*Poa sp.*) and sedges (*Carex*), bluebells (*Mertensia sp.*), starry solomon-plume (*Smilacina stellata*), bedstraw (*Galium trifolium*), lamb's-quarters (*Chenopodium alba*), clover (*Trifolium sp.*), and cow parsnip (*Heracleum lanatum*). Cover varies, based on ocular estimates, from 90 to 100 percent. No evidence of stresses on riparian vegetation (chlorotic conditions or lesions) was noted. Species composition along the river (from water quality stations 24 to 1) varies according to the amount of man-made disturbants and river flow conditions, which would be expected.

Palustrine wetlands along the river (Figure 3.7-2) are present where the soil is saturated most of the time. Species found in these wetlands include cattails, willows, sedges, smartweed (*Polygonum sp.*), and mint (*Mentha sp.*).

The Portneuf wetlands provide habitat, food sources, and resting area for a variety of wildlife species, such as beavers, ducks, geese, and waterfowl. The northern area of the American Falls Reservoir, including the mouths of the Portneuf and Snake rivers (Portneuf and Fort Halls Bottoms), provides habitat for overwintering and nesting of a variety of migratory species, including waterfowl shorebirds, waterbirds, and special status species, such as the bald eagle and trumpeter swan. In an arid environment where water is a limiting factor, such as in the vicinity of the EMF facilities, open water is attractive to a variety of wildlife, especially migratory waterfowl.

Other Wetlands. The U.S. FWS wetland inventory maps (1980) also identified four wetlands associated with excavated areas such as gravel and borrow pits and irrigation canals that are classed as palustrine (Figure 3.7-2). These areas were examined in the field during the

September reconnaissance. The excavated areas were denuded of vegetation and, because of their location and level of human activity and disturbance, provide limited wildlife habitat.

Five palustrine emergent wetlands in agricultural fields in the EMF study area that were identified by the U.S. FWS (1980) were devoid of vegetation at the time of the reconnaissance (September) or could not be located. It is likely that the wetlands that could not be located had been altered and farmed or were not evident because of the time of year. Because these wetlands and the surrounding area have been disturbed for agriculture, they do not provide important wildlife habitats.

The five wetlands identified on the wetland inventory maps (U.S. FWS, 1980) along irrigation canals were associated with seepage areas. Species observed included cattails (*Typha latifolia*), sedges, and grasses. These wetlands provide some wildlife habitat for loafing and resting, but they are not significant because of the limited areal extent (less than 0.1 acre/0.04 hectare [ha]) and the varying water regimes in the irrigation canals.

Five palustrine emergent wetlands were identified on the Fort Hall Indian Reservation in association with springs (U.S. FWS, 1980). These were not examined in the field but, on the basis of their location, would be expected to provide good wildlife habitat for food, cover, and nesting.

Agricultural Areas

Agricultural areas, including fallow and disturbed areas (Figure 3.7-2), make up 40 percent (7,203 acres/2,916 ha) of the area within a three-mile radius of the EMF facilities. The predominant crops are potatoes and wheat. The predominant animal species include killdeer, magpies, bluebirds, blackbirds, mice, coyote, foxes, badgers, and mule deer.

Numerous clumps of even-aged old and dying cottonwood trees (*Populus angustifolia*) were noted adjacent to several old farmhouses in the agricultural areas (Figure 3.7-2). Most of these trees (over 40 feet [12 m] tall) were dead or dying, especially where the farmhouses were dilapidated or in shambles. These clumps appear to be dying from old age or from purposeful girdling. Other tree species adjacent to the cottonwoods, such as plum and ornamental junipers, appeared healthy. While some regeneration was noted on the cottonwoods, their appearance was typical of senescent cottonwood trees.

Other

Residential, industrial, and commercial areas make up approximately 20 percent of the area within a three-mile radius of the EMF facilities (Figure 3.7-2).

EMF Facilities–Onsite Vegetation and Habitat Types

Historically, the area of the EMF facilities was sagebrush steppe. Because of the disturbance associated with the facilities, little of this vegetation/habitat type remains. Vegetation habitats are found in the southern part of the facilities (Figure 3.7-2).

Except for these areas and the bluffs to the south of the EMF facilities, the undeveloped areas on the sites have low potential as wildlife habitat due to the surface disturbance and continual activities onsite. Open disturbed areas in both facilities are weedy or mostly bare ground, providing limited cover for wildlife such as small rodents, quail, foxes, and rabbits. Plant species observed at the EMF facilities include Russian thistle and brome grass (*Bromus tectorum*), with occasional rabbitbrush.

Areas on the southern edge of the Simplot facility presently are sagebrush steppe. Species found in these wetlands include cattails, willows, sedges, smartweed, and mint. In addition, steep rugged cliffs in Sections 18 (T5S 34E), 23, and 24 (T6S R33E) provide habitat for nesting raptors and may be potential habitats for bats.

At the FMC facility, the IWW ditch conveys noncontact cooling water from the IWW basin to the Portneuf River. Vegetation growing along this ditch includes Russian olive, alder, and elm trees, and weedy herbaceous species such as Russian thistle, dandelion, stinging nettle, and wild lettuce (*Lactuca sp.*). The trees along the drainage ditch provide limited nesting and cover habitat for small birds.

However, because of the activity in the surrounding facility and because there is other more productive habitat nearby along the Portneuf River, this area does not provide important wildlife habitat. This is also true of other equivalent areas identified at the FMC and Simplot properties.

A small wetland area, approximately 0.02 acre (0.01 ha), is located at the entrance of the FMC plant, between the grassed welcome area next to the check-in station and railroad tracks. Cattails (*Typha latifolia*), willows (*Salix exigua*), annual sunflower, Russian thistle, and brome grass (*Bromus sp.*) were noted in this area. Given the size of this wetland, and its proximity to the railroad and entrance to the FMC facility, it is of limited wildlife value. The wetland probably serves as a small retention basin for runoff from the grassed welcome area, with runoff being impounded by the railroad tracks and entrance road.

Special Status Plant Species

According to the Idaho Conservation Data Center, Nongame and Endangered Wildlife Program, Idaho Department of Fish and Game, no rare, threatened, or endangered plant species are known to occur in the EMF study area (Stephens, 1992).

3.7.1.2 Sensitive Habitats and Wildlife

Sensitive habitats are defined as those that are critical habitats designated for threatened or endangered species, special habitats designated by state and federal agencies, and wetland and riparian habitats.

Critical and Special Habitats

No critical habitat for threatened or endangered species or special habitats designated by the state or by federal agencies occur within the EMF study area, including at the EMF facilities.

The American Falls Reservoir, part of the Minidoka Wildlife Refuge System, occurs approximately 8 river miles downstream of the EMF facilities. Extensive wetland and riparian areas occur around the perimeter of the American Falls Reservoir. The northern area of the American Falls Reservoir, including the mouths of the Portneuf and Snake rivers (Portneuf and Fort Hall Bottoms), provides habitat for overwintering and nesting of a variety of migratory species including waterfowl, shorebirds, waterbirds, and special status species such as bald eagle and trumpeter swan. Use of habitats in the EMF study area by some species is influenced by the proximity of the habitats to the American Falls Reservoir.

Wetland and Riparian Habitats

Numerous wetland/riparian habitats associated with Michaud Creek, Portneuf River, and adjacent springs, borrow areas, and irrigation canals in the EMF study area are described in Section 3.7.1.1.

EMF Facilities–Onsite Sensitive Habitats

One wetland occurs within the EMF facilities area. This very small wetland on the FMC property provides limited value for wildlife because of its location, (next to a railroad bed and shale ore dumper), size, weedy species composition, and lack of structural cover. See Section 3.7.1.1 for further description of this wetland.

In an arid environment where water is a limiting factor, such as in the vicinity of the EMF facilities, open water is very attractive to a variety of wildlife, especially migratory waterfowl. Therefore, some discussion is warranted regarding open water as a habitat for sensitive waterfowl species.

The surface impoundments (e.g., Ponds 8S, 8E, 11E, 12S, 13S, 14S, 15S, and 16S) at the FMC facility sometimes attract waterfowl for loafing and resting in standing water. In cooperation with the Idaho Department of Fish and Game, FMC has installed propane-operated Sonar® guns around these ponds to discourage waterfowl from landing. These devices operate 24 hours a day.

In addition to the sonar guns, FMC's full-time pond crew uses shotgun firing blanks or special rounds, when available from Idaho Fish and Game, and slingshots to keep waterfowl off the ponds. FMC's experience is that the combination of these techniques is almost 100 percent effective in deterring use of the ponds by migratory game waterfowl such as ducks and geese. These migratory game species may land from time to time, but do not remain on the ponds for any length of time. The techniques described above are less effective with American avocets.

Standing water on the gypsum stacks on the Simplot facility potentially could attract waterfowl and other wildlife in the adjacent sagebrush steppe habitats. Waterfowl attraction to this area would be low and occasional due to sparse vegetative cover around the edges of the stacks, and the amount and distribution of standing water on the stacks. No records are available of any wildlife use of these areas (Wolleson, 1992).

The Simplot dewatering pit, equalization pond, settling pond, and holding pond could also attract waterfowl and other waterbirds, although this would probably be limited to occasional loafing. Approximately 30 Franklin gulls were observed loafing on the surge pond northeast of I-86 during field reconnaissance in September 1992. Use of these ponds, however, is probably not significant since little vegetation grows adjacent to the ponds that would provide cover and food, and higher quality habitats nearby along the Portneuf River would be preferable (Figure 3.7-2).

Sensitive Wildlife

Sensitive wildlife is defined as those species that are state or federally designated as threatened and endangered, candidates for listing, and species directly in the human food chain.

Appendix G contains a list of all known wildlife species, both special status and nonspecial status, occurring on the Fort Hall Reservation and in habitats in the EMF study area.

The major habitats in the study area support species common to sagebrush steppe and riparian areas in southeastern Idaho (Groves and Marks, 1985). Other sensitive species that utilize habitats along the American Falls Reservoir also move up the Portneuf River and use its wetland

and riparian habitats and the adjacent agricultural areas. However, the populations of waterfowl and other species present are not expected to be as large as those reported for the American Falls Reservoir and Snake River.

Riparian/wetland habitats along the Portneuf River within the Fort Hall Indian Reservation and those associated with springs in the EMF study area make up the most important habitat types in the study area. These areas provide food sources, cover, and nesting habitat as well as movement corridors for sensitive species including waterfowl, white-tail deer, and mule deer. No data are available on population sizes or trends in the study area for waterfowl, nesting colonial waterbirds, or upland game birds and big game species (Anderson, 1992; Trost, 1992; Christopherson, 1992).

The occurrence and use of habitats by special status species in the EMF study area are discussed below by species and species group.

Bald Eagles. Bald eagles (*Haliaeetus leucocephalus*) utilize habitats on and around the American Falls Reservoir as either winter migrants or nesting residents. The overwintering eagles are made up of two populations, one that uses the reservoir and Snake River, and one that uses habitats south of the American Falls Dam. The nesting residents occur along the Snake River near McTucker Island in Bingham County (Howard, 1992a), approximately 17 miles (30 km) northwest of the EMF facilities.

Since 1980, the U.S. FWS, BLM, and Idaho Department of Fish and Game have conducted midwinter bald eagle surveys to estimate the size of overwintering populations. Over the last 12 years, populations at the American Falls Reservoir have ranged from a high of 57 in 1981 to a low in 1986 of four (BLM data files). In 1990, counts totaled 16; in 1991, counts totaled 26; and in 1992, counts totaled 17 bald eagles. In the 1990 survey of the entire reservoir, 10 bald eagles were counted in the northeastern part of the reservoir, and in 1991, 17 bald eagles were counted in the same area (Idaho Department of Fish and Game, 1990-1991). These numbers provide a general index of the population of bald eagles using the northeastern portion of the reservoir, including the Portneuf River floodplain.

In the northeastern portion of the American Falls Reservoir, bald eagles are most frequently observed along the Snake River drainage and mouth of the Snake River in open water where waterfowl congregate and at the mouths of Spring Creek, Clear Creek, Portneuf River, and Bannock Creek. Use in these areas varies depending upon open water and the aggregation of waterfowl in the area. Waterfowl concentrations vary yearly, depending upon areas of open water (Idaho Department of Fish and Game data files and Howard, 1992b).

Sightings of bald eagles in the northeastern portion of the American Falls Reservoir for 1992 were summarized by the Bureau of Reclamation on GIS maps for the American Falls Resource Management Plan (U.S. Department of the Interior, 1992). Concentrations of wintering bald eagles were mainly in the Snake River Drainage and open waters of the American Falls Reservoir. Three bald eagle sightings were recorded in the Portneuf River floodplain in Sections 26 and 27 (R33E, T5S) in 1992 by Bureau of Reclamation biological consultants.

No night roost locations are known along the Portneuf River or the Portneuf floodplains; however, the U.S. FWS and Idaho State University experts (Howard, 1992a; Trost, 1992) indicated that eagles occasionally use trees as day roosts along the Portneuf River up to I-86. Eagles are thought to take wounded waterfowl that move up the Portneuf River for cover during waterfowl hunting season in the winter. Bald eagles also take fish in the 7- to 20-inch (18- to 51-cm) size classes. Other prey sources include black-tailed jackrabbit (*Lepus californicus*) and deer and livestock carrion (Howard, 1992a). During the February 1993 reconnaissance, an immature bald eagle was observed hunting along the Portneuf River in Section 26 R33E T6S.

No known eagle nest has been identified in the Portneuf River floodplains area. The closest known eagle nest to the American Falls Reservoir is on the Snake River in Bingham County, over 6 miles (9.6 km) northeast of the Portneuf River mouth (Howard, 1992a).

Bald eagles may occasionally use the Portneuf River for hunting, but this would depend upon the overwintering bald eagle population size in the northeastern part of the American Falls Reservoir, waterfowl concentrations and distributions, weather, and open water on the American Falls Reservoir.

Peregrine Falcon. Peregrine falcons (*Falco peregrinus*) are known to migrate through the vicinity of the American Falls Reservoir (Trost, 1992; Cooper, 1992) and could be expected to occasionally use habitats in the EMF study area for hunting during migration. Peregrine falcons forage in areas of low vegetation, and their prey base includes waterfowl and passerine birds.

Other Raptors. Most of the raptor species listed in Appendix G are common in the open country of southeastern Idaho. Migratory raptors include peregrine falcon, Gyrfalcon (*Falco rusticolus*), ferruginous hawk (*Buteo regalis*), rough-legged hawk (*Buteo lagopus*), Cooper's hawk (*Accipter cooperii*), osprey (*Pandion haliaetus*), and northern harrier (*Circus cyaneus*).

The golden eagle (*Aquila chryaestos*) and prairie falcon (*Falco mexicanus*), historically have nested south of the EMF facilities in the bluffs (Howard, 1992a; Renn, 1992; Hogander, 1992). Historic golden eagle nest sites are in the NE 1/4 of Section 19 R34E, T6S. Prairie falcon eyries have been located in both the SE 1/4 of Section 19 R34E, T6S and SE 1/4 of Section 24 R33E, T6S. Both species' nests were successful in 1990, according to Renn (1992). During the spring reconnaissance in June 1993, the golden eagle nest site listed above was active. Two eaglets were observed in the nest, and an adult was observed soaring in the vicinity. No active prairie falcon eyries were noted. A kestrel nest was noted in a juniper snag in Section 19 R34E, T6S.

The following section describes the ecology of two representative raptors, the red-tailed hawk (*Buteo jamaicensis*) and the barn owl (*Tyto alba*), observed or expected near the EMF facilities.

The red-tailed hawk is a daytime avian predator of ground dwelling vertebrates, particularly rodents and other small mammals. They hunt primarily from an elevated perch, often near woodland edges (Bohm, 1978a; Janes, 1984; Preston, 1990).

Nesting sites in low density forests are found close to the tops of trees (Bednarz and Dinsmore, 1982), and when trees are scarce, nests are built on other structures, on rock pinnacles, ledges, or man-made structures (Brown and Amadon, 1968; MacLaren et al., 1988). The primary diet for this species consists of small mammals including mice, shrews, voles, rabbits, and squirrels. They also eat a wide variety of foods depending on availability, including birds, lizards, snakes, and large insects (Bent, 1937; Craighead and Craighead, 1956; Fitch et al., 1946). The red-tailed hawk is opportunistic and will feed on whatever species are most abundant (Brown and Amadon, 1968). The hawks egest pellets containing undigestible part of their prey, such as hair and feathers. The bones are usually completely digested.

Red-tailed hawks are found in habitats ranging from woodlands, wetlands, pastures, and prairies to deserts (Bohm, 1978b: Gates, 1972; MacLaren et al., 1988; Mader, 1978). The preferences are for a mixed landscape containing old fields, wetlands, and pastures for foraging, interspersed with groves of woodlands and bluffs and streamside trees for perching and nesting (Brown and Amadon, 1968; Preston, 1990). Moderately shallow (7.6 to 15.1 m height) cliffs along the river bank were the preferred habitat in a Snake River population (U.S. Department of the Interior, 1979). Riparian sections and the bluffs south of the EMF facilities ideally provide the most suitable habitat. Home range size can vary from a few hundred hectares to over 1500 hectares (3,706 acres).

Barn owls are primarily night hunters, although they will hunt during winter days. These behaviors correspond to the activity patterns of their primary prey, small mammals. Hunting typically occurs from perches that are one to three meters above the ground, and has been found to occur within a 530 ha (1,310 acres) area of the nesting site (Avery, 1992; Gubayni et al., 1992). Preferential small mammal habitat is provided by long strips of grassland bounded by edge areas of fence rows, ditches, hedges, and woodlands (Taylor 1994). The primary diet for the barn own consists of mice, moles, shrews, cotton rats, barn rats, gophers, ground squirrels, cottontails, and jackrabbits (Bent, 1938). Owls consume their prey whole, and egest the skeletal pellet. Smith and Richmond (1972) observed gastric pHs of approximately 2.0 to 5.0 in an adult barn owl immediately before feeding. The data suggest that the adult owl would not absorb significant concentrations of minerals associated with the prey's bone matrix.

Barn owl reproductive success is apparently directly related to small mammal availability and the amount of rainfall (which increases rodent populations; Colvin, 1984), and is inversely related to the extent of human disturbance and agricultural practices (Gubanyi et al., 1992). Taylor (1994) observed that egg production is positively related to the extent of surrounding suitable forage habitat. Barn owls spend their day roosting in old buildings, caves, hollows of trees, or thick foliage, such as pines or cedars (Terres, 1991). Roosting on the ground in agricultural fields has also been observed (Colvin 1984; Rosenburg 1986). In the EMF study area, the riparian and agrarian areas may provide more suitable habitat than the sagebrush-steepe areas because of the presence of a larger number of roosting sites, a smaller amount of prey cover, and a drinking water source (the Portneuf River).

No census data are available for raptor populations in the EMF study area. Idaho Fish and Game Department biologists indicate that the populations are at carrying capacity (Anderson, 1992; Cooper, 1992) given the type of habitats in the area and agricultural activities. During the winter reconnaissance along the Portneuf River, five species of raptors were observed hunting along the river, including the rough-legged hawk, marsh hawk, red-tailed hawk, great horned owl, and golden eagle. During the spring reconnaissance, marsh hawks, kestrels, and golden eagles were observed in the EMF study area.

Waterfowl. Numerous waterfowl species winter in the American Falls Reservoir area, and most of the species listed in Appendix G would be expected to occur in the wetlands and riparian habitats and open water along the Portneuf River. The U.S. Department of Interior

Bureau of Reclamation maps (1992) show waterfowl nesting and brooding habitat as well as spring aggregation areas extending up along the Portneuf River and adjacent wetland riparian habitats to Section 36 R34E, T6S. The agricultural fields adjacent to the river also provide food for numerous species including Canada geese (*Branta canadensis*), goldeneye (*Bucephala clangula*), and ruddy ducks (*Oxyura jamaicensis*) (Trost, 1992).

Population sizes of waterfowl in the wetlands and riparian habitats along the Portneuf River are not available. Summaries are available of Idaho Department of Fish and Game surveys as part of the U.S. FWS winter waterfowl surveys for Region 5 (American Falls Reservoir, Snake River to Massacre Rocks up to Blackfoot River and Fort Hall Bottoms). The winter survey counts for winter waterfowl (mallards, *Anas platyrhynchos*; gadwell, *Anas strepera*; wigeon *Anas americana*, green- and blue-winged teal, *Anas crecca* and *A. discors*; pintail; redhead, *Aytha americana*; goldeneyes; buffleheads, *Bucelphala albeola*; ruddy ducks; mergansers, *Mergus merganser*; Canada geese; snow geese, *Chen caerulescens*; swans, *Cygnus sp.*) are summarized in Table 3.7-2.

Duck and goose harvest data for the Fort Hall Bottoms of the Fort Hall Indian Reservation area (Shoshone-Bannock Tribe, 1992) are summarized in Table 3.7-3. Mallards are considered to be the most important of waterfowl species for hunting on the Fort Hall Indian Reservation (Christopherson, 1992).

The above-mentioned overwintering surveys covered a larger habitat area than that along the Portneuf River in the EMF study area. These estimates, however, provide a general index of fluctuations in population sizes and species in the area, which proportionally would be reflected in concentrations and occurrences along the Portneuf River and adjacent wetland and riparian habitats similar to those surveyed along the American Falls Reservoir. During winter reconnaissance along the Portneuf River, waterfowl groups dominated by mallards occurred in sizes up to 200 individuals. Other less numerous species observed in shallow, sheltered areas along the river include widgeon, goldeneye, redhead, teal, and Canada geese. During spring reconnaissance, up to 20 mallard pairs were flushed along the river from Batiste Springs Road to the mouth of the Portneuf River.

Colonial Nesting Waterbirds. Colonial nesting waterbirds are addressed in this characterization since they are at the top of the aquatic food chain, and use aquatic and riparian habitats along the Portneuf River. Three species of colonial nesting waterbirds — great blue herons (*Aredea herodias*), black-crowned night herons (*Nycticorax nycticorax*) and white pelicans (*Pelecanus erthrorhynchos*) — occur in the EMF study area along the Portneuf River. During spring reconnaissance, no nest sites were observed along the Portneuf River from Pocatello to the mouth of the Portneuf River.

Black-crowned night herons have been reported feeding at the fish farm at Batiste Springs (Henny and Burke, 1990; Trost, 1992). These birds are not considered year-long residents but migrate to Mexico (Trost, 1992).

The closest heron rookery (not active) documented during field reconnaissance was noted approximately 8 miles (13 km) downriver in Section 22 R33E T5S at the mouth of the Portneuf River. Approximately 10 nests were observed during the October 26-30, 1992, sediment sampling. Because of high waters and inclement weather in the spring, this area could not be examined for activity.

White pelicans also hunt along the Portneuf River on the Fort Hall Indian Reservation, taking suckers and carp (Christopherson, 1992). Maps for the U.S. Department of Interior Bureau of Reclamation (1992) of pelican use areas show that two concentration areas occur in the northwestern part of the American Falls Reservoir[about 15 miles (24 km) from the EMF site] and a smaller use area occurs between the Portneuf River mouth and 2 miles (3.2 km) north of Bronco Point along the reservoir. During spring reconnaissance, four white pelicans were observed on the river near river mile 10, and up to 50 were seen at the mouth of the Portneuf.

Upland Game Birds and Big Game. Numerous upland game birds and big game occur in the EMF study area. Appendix G lists the species and habitats in which they occur. No data are available from the Idaho Department of Fish and Game or Bureau of Land Management regarding harvest data or populations of upland game birds, mule deer, and white-tail deer in the EMF study area. Pheasant harvest data on the Fort Hall Indian Reservation in agricultural and wetland habitats show harvests of 675 in 1988, 1,090 in 1989, and 1,084 in 1990 (Shoshone-Bannock Tribe, 1992). Two chukar were observed in the EMF facilities area and on the face of the gypsum stack during spring reconnaissance.

Sage grouse occur in the sagebrush steppe habitats in the study area. However, no data are available on populations (Anderson, 1992; Christopherson, 1992).

While no harvest data are available for mule deer and white-tail deer (*Odocoileus virginianus*) in the EMF study area, both species are considered important hunting resources on the Fort Hall Indian Reservation.

Mule deer frequently inhabit semiarid, open forest, brush, and shrub lands and are especially abundant in mountain-foothill regions. Population densities in the EMF study area would be similar to a mix of open and broken prairie ($\leq$0.5 to 4.5 deer/km^2) (Mackie et al., 1982). Mule deer concentrate in areas of substantial topographic and vegetative diversity, including breaks along river drainages, heavily dissected badlands, and brushy stream courses (Hamilton 1978a,b). Foothills and mountains often sustain dense populations (4-7 to 16 deer/km^2).

The mule deer is a herbivore. It feeds on a wide variety of plant species, including trees and shrubs, forbs, grasses, sedges, and rushes (Mackie et al., 1982). Generalizing the mule deer's diet is extremely difficult due to its dynamic nature; however, a dietary study of mule deer in western Wyoming can serve as a rough approximation. This study found a seasonal rotation in diet. Key winter browse species included big sagebrush, bitterbrush, juniper, and snowbrush (Ingles, 1965; Thomas, 1991; Wallmo, 1981; Welch, 1983). In the spring and summer, the leaves of woody plants remain the primary food source with forbs and grasses, such as alpha and bunch grass increasing in importance (Taylor, 1956). During the late summer and early fall, berries and other fleshy fruit, such as bitterbrush, chokecherry, and serviceberry, become an important food source (Holte, personal communication). Mule deer are well adapted for arid environments and cope well with a scarcity of water.

In the EMF study area, mule deer habitat occupancy may be seasonally determined. During the transitional climate of spring, mule deer are expected to primarily feed on bunch grasses and fibrous plants characteristic of sagebrush steppe. Bitterbrush and juniper may provide primary nutrition sources. After a brief early summer stay at higher elevations, mule deer may graze on the more succulent vegetation of the riparian section. During mild winters, the sagebrush steppe habitat south of the facility should again represent the preferred habitat. However, migration from this area would be expected during periods of heavy snow accumulation. Therefore, depending on climatic conditions, winter range of the mule deer can vary from the sagebrush-grass vegetation type upward into the mountain brush cover type. In semidesert range, home ranges for males and females were found to be 12.4 km^2 and 10.6 km^2, respectively (Rogers et al., 1978). Therefore, under most (non-migratory) conditions, the home range of mule deer is sufficiently large that exposure to EMF-related impacted areas would be minimal.

Bats. Potential habitat of a Federal Category 2 species, the Townsend's big eared bat (*Plecotus townsendii*) occurs immediately south of the EMF facilities in the bluffs. This species, which is being proposed for listing as a threatened or endangered species, has been observed in habitats within 6.2 miles (10 km) of the bluffs in similar habitats (Wackenhut, 1992). No records occur on the Idaho Conservation Data List. Dr. Barry Keller, Curator of Mammals, Idaho Museum of Natural History, has also indicated a high probability of occurrence of this species based upon habitat (Keller, 1992).. No bat activity was noted during spring reconnaissance in the cliffs on or south of the EMF facilities. In addition, no sightings of bat activity were reported by the U.S. FWS, BLM, or the Idaho Department of Fish and Game.

Other Mammals

A variety of mammals common to sagebrush steppe and agrarian habitat are found near the EMF facilities. For example, the red fox (*Vulpes vulpes*), is a representative mammalian predator, primarily existing in or near open agrarian fields. Foxes prey mainly upon small mammals, but also feed upon birds, insects, and fruit (Korschgen, 1959; Samuel and Nelson, 1982). In addition to hunting, foxes scavenge carcasses (Voigt, 1987) and feed on plant material, primarily fruits, berries and nuts when available. Green and Flinders (1981) found rodents, especially cricetid mice, to be the prevalent food item in all seasons in southeastern Idaho.

The basic social unit of foxes is the family, which generally consists of a mated pair or a male and several related females (Voigt, 1987; MacDonald, 1980). Additional females are usually nonbreeding and often help the breeding female (Voigt, 1987).

Home ranges of foxes from the same family often overlap to a considerable degree, creating a larger family territory (Sargeant, 1972; Voigt and MacDonald, 1985). Family territories are largely contiguous and nonoverlapping resulting in a landscape which is almost entirely utilized by foxes (EPA, 1993). While territory sizes range from 50 to 3,000 ha (124 to 7,413 acres), one family's territory is typically 100 to 1,000 ha (247 to 2,470 acres) in size (EPA, 1993). Red foxes are readily adaptable and live in numerous habitats: cropland, rolling farmland, brush, pastures, hardwood stands, and coniferous forests (MacGregor, 1942; Eadie, 1943; Cook and Hamilton, 1944; Ables, 1974). Broken and diverse habitats, such as agricultural regions, are particularly preferred (Ables, 1974; Samuel and Nelson, 1982; Voigt, 1987). In Idaho, red foxes were documented to be inhabiting new terrains previously unoccupied by the species, including cultivated areas, cool deserts of the foothills, and the Snake River Plain (Aubry, 1984).

3.7.2 AQUATIC ECOSYSTEMS

Aquatic habitat in the Portneuf River is generally shallow riffles with cobble and gravel substrate in the immediate area of the EMF facilities, changing gradually into deeper habitat with slower currents and more mud/silt substrates near Siphon Road. The low stream banks typically support temporarily flooded shrub communities. Springs and groundwater hydrology are major influences on the aquatic habitat near the EMF facilities and downstream. Groundwater and springs significantly increase the river flow and tend to be warmer in winter and cooler in summer than the upstream river water. This provides a more stable aquatic habitat by limiting temperature extremes in the river. Luxuriant growths of macrophytes occur in the sections of the river influenced by the numerous springs.

Water quality is reduced by numerous point and nonpoint sources both above and below the FMC outfall.

No endangered or threatened species and no critical habitats were identified in the EMF study area. Important aquatic species in the area include game fish and sucker (which are eaten by people), and mottled sculpin, which is probably the second most common fish in the Portneuf River and a significant food source for many of the higher vertebrates. Macroinvertebrates are also a major food source for fish, birds and amphibians, and are important in determining the well-being of those populations.

Two fish farms on the Portneuf River below the EMF facilities raise coho salmon and rainbow trout for stocking other streams and for human consumption.

3.7.2.1 Aquatic Habitats

The only significant aquatic habitat in the EMF study area is the Portneuf River. The hydrology and water quality of the Portneuf River are described in Sections 3.2 and 4.5, respectively. Surrounding land uses and water uses, according to the City of Pocatello (1989), have had a marked effect on the quality of the aquatic habitat in the Portneuf River. Public health warnings were issued during the study period regarding avoidance of contact sports in the river due to bacterial contamination resulting from untreated sewage discharges (Low, 1993). Water quality improves markedly with the introduction of groundwater underflow and springs below I-86.

From I-86 downstream to the diversion dam near Siphon Road, the deepest portion of the Portneuf channel (the thalweg) changes from shallow riffle habitat with predominately cobble and gravel substrate habitat to deeper habitat with slower currents and mud/silt substrate habitat, as observed during field reconnaissance. The channel margins reflect depositional characteristics of the natural flow regime (i.e., point bars and chute bars). Further information on river morphology is provided in Section 3.2.1. The amount of mud and silt in this portion of the river may also change with seasonal flow. The diversion dam at Siphon Road is removed each year before high water flow. Below this diversion dam, bottom materials are again predominantly cobble and gravels down to the Fort Hall Bottoms.

Hydrology

The hydrology of the Portneuf River is described in detail in Section 3.2 and only the information relevant to characterizing the aquatic habitat is summarized here.

The annual hydrograph of the Portneuf River (Figure 3.7-3) is generally dominated by spring high water runoff from the melting of mountain snowpacks. Flows are at minimum levels during the summer months. RI data confirm this flow pattern.

The Portneuf River becomes a gaining stream north of I-86, and is recharged by underflow from groundwater. In the EMF study area, numerous springs enter the river downstream (north) of I-86. (Flow quantities from these springs and other sources of the Portneuf River are described in Section 3.2.) The Pocatello STP also discharges into the Portneuf River about 0.8 mile (1.3 km) below the EMF facilities, and 0.6 (1.0 km) mile downstream from I-86.

In addition to spring tributaries that have identifiable confluences with the Portneuf River, other areas of groundwater discharge within the river channel are visibly apparent as indicated by patterns of water clarity, temperature, and the distribution of aquatic macrophytes (Brock, 1989). The surface and groundwater hydrology of this reach of the Portneuf River is very complex and is a major influence on the aquatic habitat.

In the EMF study area, the Portneuf River ecosystem has two annual critical periods related to flow and pollution. The first is the high-flow or runoff season, which may create the following stresses on the river ecosystem:

- High-velocity water flows wash away food for aquatic organisms.
- Habitats are disrupted by the high flows (800 cfs [22 cms] or more).
- High levels of suspended sediments are washed into streams, covering up needed food and blocking the amount of sunlight that reaches the oxygen producers such as algae and macrophytes (rooted aquatic plants).
- Toxic materials can be washed into a stream at this time. (Note that runoff is controlled at the EMF facilities and does not enter the river.)
- There can be significant morphological changes as stream banks are cut and sloughed and meanders are altered.

The second critical period is during the summer when flow is low and stresses may be created by the following (McSorley, 1976):

- High temperatures, which reduce dissolved oxygen (DO) concentrations.
- Greater impacts of City of Pocatello wastewater discharge. (The City of Pocatello has minimized this impact since 1980 by diverting treated effluent to irrigation.)
- Tendency to concentrate toxic materials and nutrients in water.
- Reduced habitat (decreased areal extent of river) for macroinvertebrates and fish.

Table 3.7-4 shows the width, depth, and flow characteristics at selected locations on the Portneuf River observed in the field on October 27, 1992. River flow increases significantly below Batiste Road (and I-86) due to the groundwater underflow and spring discharges. Based upon field reconnaissance of the river in 1992, aquatic plants (both rooted and floating) appeared to be much more abundant below I-86 in comparison to the stretches upstream of the EMF facilities.

Land Use and Vegetation

The predominant land use along the river is undeveloped with native riparian vegetation. A few areas near Pocatello are disturbed by construction or industrial activities; most other disturbances are due to agricultural activities, particularly livestock, and breakdown on river banks (Section 3.6.2, Land Use, and Figure 3.7-2).

Stream banks along the Portneuf River typically support temporarily flooded shrub communities. Peachleaf willow and alder are the common overstory species while sedges, grasses, and forbs tend to dominate the herbaceous layer. Dense thickets of coyote willow are common in the intermediate shrub layer. The peachleaf willow and alder overstory commonly reach heights of 27 to 36 feet (8 to 11 m); the intermediate shrubs (e.g., coyote willow, rose, currant, and red osier dogwood) typically reach 5 to 10 feet (1.5 to 3 m) in height. The herbaceous layer typically include basin wildrye, brome, timothy, festucea, spiny hopsage, and thistle. The river canopy is mostly open, with scattered groups of peachleaf willow and alder covering the river. The shrub and grass layers tend to be thick and overhang the banks. The riparian/wetlands along the river are also discussed in Section 3.7.1.2.

Water Quality

The quality of the groundwater and surface water is discussed in detail in Section 4 of this report. The information presented here emphasizes the ecological aspects. Water quality is one of the primary considerations in determining habitat quality for aquatic organisms.

Pollution sources such as the Pocatello STP, uncontrolled raw sewage discharges containing E. coli bacteria, and storm water runoff from the urbanized areas affect the water quality of the Portneuf River. Other important pollutants entering the Portneuf River include suspended solids from tilled croplands, organic wastes from cattle, nitrogen and phosphorus compounds from fields, and animal wastes (Minshall and Andrews, 1973). FMC currently discharges noncontact cooling water to the Portneuf River under an NPDES Permit. Until 1980, Simplot also discharged effluent from its water treatment ponds to the river. The nutrient-rich effluent is now collected and sold for irrigation and fertilization.

Pocatello's STP discharges to the river from the east bank, about 0.9 mile (1.5 km) downstream (north) from FMC's IWW ditch outfall. According to the City of Pocatello (1989), the STP effluent has an organic content typical of well-operated secondary treatment facilities (5-day, biological oxygen demand, and total suspended solids are each typically lower than 20 mg/l). Ammonia is a normal degradation product of proteins. Figure 3.7-4 illustrates the variability during the 1988-89 study period in ammonia-nitrogen content of the plant's effluent (City of Pocatello, 1989).

As reported by the City of Pocatello (1989), factors that are relevant to mixing characteristics of the STP effluent are the nature of the discharge (a straight pipe on the east bank of the river), and the presence of a medial bed of macrophytes that virtually divides the channel in two for the first 330 to 660 feet (100 to 200 m) downstream from the discharge point. The medial macrophyte bed and the discharge of a portion of Batiste Spring nearly opposite the effluent pipe combine to provide a zone along the west bank of the river which, according to the City of Pocatello, appeared to have been minimally impacted by the STP effluent (City of Pocatello, 1989).

Groundwater underflow and discharge from Batiste and Swanson Road springs also have an important impact on the water quality of the Portneuf River. Groundwater and springs tend to be warmer in winter and cooler in summer than water reaching the area from upriver. Like many rivers that attain their maximum water temperature during minimum flow periods of summer, the lower Portneuf is warmest when the river flow is lowest. As indicated by the City of Pocatello (1989), the moderate temperatures found in the gaining reach influence ecological processes in several ways, including lowering of respiration rates, reducing the fraction of ammonia that is in an un-ionized (toxic) form, and increasing the solubility of dissolved gases, such as oxygen.

The DO concentration at a sample point in a river for a given time is a function of numerous factors operating upstream including: physical influences (temperature, pressure, gas solubility, and channel characteristics that affect reaeration); and the biomass and rates of activity of organisms that release and consume DO through life processes such as photosynthesis and respiration. Data reported by the City of Pocatello (1989) from the Portneuf River at the Rowland creamery follow a typical pattern of increasing DO during the day, associated with photosynthesis, and decreasing DO at night, due to respiratory processes (Figure 3.7-5). Diel swings (cyclic increases and decreases over the day) in DO at the Rowland creamery were more pronounced during the fall of 1988 than in the summer of 1989. The City of Pocatello maintains this is probably due to greater accumulation of plant biomass in the river channel later in the growing season. (The influx of groundwater and spring water to the Portneuf downstream from Batiste Road is accompanied by substantial macrophyte beds that typically cover half the channel.).

Downstream from the STP discharge, the minimum daily DO at dawn as measured by the City of Pocatello (1989) was in excess of 5.5 mg/l (60-percent saturation), even in midsummer. Such DO levels are considered adequate to maintain a salmonid fishery. In this study, DO levels tended to be slightly lower (about 0.5 mg/l) at the fish farm site than at the Rowland creamery. The City of Pocatello concluded that this would be expected, due to in-stream conversion of ammonia to nitrite and nitrate (nitrification), a chemoautotrophic process that requires oxygen. There was no evidence of toxic oxygen conditions associated with Pocatello's STP effluent in the study reach, even under conditions that would be potentially most stressful (i.e., maximum summer temperatures with minimal dilution of treatment plant effluent) (City of Pocatello, 1989).

According to the Idaho Department of Health and Welfare, Division of Environmental Quality (1989), storm drain discharges from the City of Pocatello are a potential major source of contaminants to the river. Chemical analyses of drain water indicated levels of suspended solids, total solids, chemical oxygen demand, sodium, potassium, chloride, fluoride, arsenic, cadmium, hexavalent chromium, copper, iron, lead, manganese, and zinc higher than any of the three major NPDES discharges to the Portneuf River.

The occurrence of a thunderstorm while continuous monitoring equipment was operational near the Rowland creamery (upstream of the STP discharge) revealed potential DO problems associated with storm runoff from the watershed. A localized storm of undocumented intensity (no rain was recorded at the Pocatello Municipal Airport weather station) on August 10, 1989, was followed by DO concentrations that fell to 3.5 mg/l during the early morning hours of August 11, and remained below the acute lethal threshold of 4.0 mg/l (EPA, 1989f) for 2 to 3 hours (Figure 3.7-5). The City of Pocatello (1989) postulated that these low oxygen levels were associated with chemical oxygen demand associated with organics washed into the channel by storm runoff as well as with organic deposits stirred up by the elevated flow of the river.

3.7.2.2 Sensitive Aquatic Species and Habitats

Sensitive aquatic species include the following categories:

- Endangered Species — Any species in danger of extinction throughout all or a significant portion of its Idaho range.
- Threatened Species — Any species likely to be classified as endangered within the foreseeable future throughout all or a significant portion of its Idaho range.

On the basis of discussions with the Natural Heritage Section of the Idaho Department of Fish and Game, and a review of the 1992 list of rare, threatened, and endangered plants and animals of Idaho (Moseley and Groves, 1992), it was determined that no endangered or threatened species occur in the Portneuf River in the EMF study area.

Sensitive habitats evaluated in this site characterization are classified as those that are critical habitat designated for threatened or endangered species, special habitats designated by state and federal agencies, and wetlands. No critical habitat for threatened or endangered species, or special habitats designated by state and federal agencies, occur in the EMF study area.

3.7.2.3 Important Aquatic Species and Habitats

These species include those fish used for human consumption and as food for other fish and macroinvertebrates. Also discussed are fish farms on the Portneuf River.

Aquatic Species Targeted for Human Consumption

Aquatic species that are targeted for human consumption are primarily game fish, which are identified in Table 3.7-5. These fish include trout (hatchery and wild rainbow, brown, and hybrid trout); kokanee salmon that have escaped from commercial fish farms; mountain whitefish, yellow perch, black crappie, and catfish (black bullhead, brown bullhead, and channel catfish). Sucker are also eaten sometimes (Sigler and Sigler, 1987). The more important fish in the Portneuf River in the EMF study area are discussed in the following subsections.

In studies reported by the City of Pocatello (1989), fish populations were estimated for four study sections of the Portneuf River immediately above and below the STP. These data were summed for the four study sections and are presented in Figure 3.7-6. It should be noted that this field study was hampered by large quantities of floating vegetation.

These data show larger populations of nongame fish than game fish and more total fish present in the fall of 1988 than in the summer of 1989. In this study, game fish consisted of brown trout, rainbow trout, and rainbow-cutthroat trout hybrids. Nongame fish included whitefish, carp, sculpin, shiner, and dace. Many of the trout captured in this study were from the fish farm at Batiste Spring. Sculpin and dace, which are considered indicators of high-quality water, were scarce below the STP, due in part to changes in water quality or habitat. However, they were still among the most common fish reported in the Portneuf River (Figure 3.7-7).

Rainbow Trout. Rainbow trout *(Oncorhynchus mykiss)* including hatchery, wild, and hybrids, are one of the most common game fish in the Portneuf River (Figure 3.7-6) and one of the most important game fish in the Great Basin (Sigler and Sigler, 1987). The Idaho Department of Fish and Game stocked the Portneuf River with 500 to 1,000 catchable size rainbow trout (about 10 inches [25/4 cm] long) for the first time in 1992, but it has no formal management program because of poor access and low fishing pressure. These fish were part of an experimental program to measure catch success (Mende, 1992). Rainbow trout in this portion of the Portneuf River are nonmigratory.

The rainbow is the easiest and most economical of all trout to raise and is raised commercially at the Papoose Spring and Batiste Spring fish farms (Figure 3.7-2). Adult nonmigratory rainbow trout average 2.0 to 4.0 pounds (0.9 to 1.8 kg) and are considered large at 5.9 to 7.9 pounds (2.7 to 3.6 kg). The life span of rainbow trout is fairly short, with few living beyond 5 years of age.

Rainbow trout generally spawn on stream gravel bars in the spring when water temperatures reach 50°F (10°C) or more. The female digs a redd in the gravel, and eggs and sperm are deposited in the depression. Rainbow and cutthroat trout that spawn in the same area often hybridize (Sigler and Sigler, 1987).

Young rainbow trout feed on small benthic invertebrates, primarily insects and crustaceans. Rainbow trout more than any other trout tend to feed on algae and, to a lesser extent, on vascular plants. The amount of nourishment received from plants and algae may be slight, however. The rainbow continues the primarily invertebrate diet until reaching a size of 1.1 to 2.0 pounds (0.5 to 0.9 kg), then it tends to turn to a fish diet when it is available. Rainbow trout are primarily drift feeders, but will rise the surface and feed on surface insects. Where forage fish such as the Utah chub are available, the larger rainbow trout will eat them (Sigler and Sigler, 1987).

Brown Trout. Brown trout (*Salmo trutta*) are present in the Portneuf River but not in large numbers (Figure 3.7-7). It is more aggressive than most trout and readily feeds on other fish. This trout is native to Europe and western Asia and was first introduced into North America in 1883. By 1910 it was regularly stocked in western streams, and is now present in most trout waters throughout the United States and Canada (Sigler and Sigler, 1987). However, the

Portneuf River is not stocked with brown trout by the Idaho Fish and Game Department (Mende, 1992). Brown trout spawn in the riffle areas from late October to December.

Brown trout usually average 3.9 to 6.6 pounds (1.8 to 3 kg) by their sixth year, and fish weighing 7.9 to 11.9 pounds (3.6 to 5.4 kg) are not uncommon. They may live 10 years or longer. In both lakes and streams, juvenile brown trout feed heavily on zooplankton and bottom-dwelling insects. A typical stream feeding pattern for brown trout as it grows older is from drift organisms and zooplankton, to aquatic and terrestrial insects, to small fish, and finally to large fish. The change to feeding on forage fish occurs at an earlier age in brown trout than most trout. Brown trout less than 2.0 pounds (0.9 kg) live largely on such insects such as mayflies, caddisflies, stoneflies, and midge larvae and pupae. Other foods include earthworms, freshwater clams, crayfish, salamanders, frogs, and rodents (Sigler and Sigler, 1987).

Besides being caught by fishermen, brown trout are preyed upon by fish-eating birds, mammals, and other fish (Sigler and Sigler, 1987). The brown trout is listed as intermediate in tolerance to environmental stress by the EPA (1989f).

Other Game Fish. Other game fish known to occur in Portneuf River include yellow perch, black crappie, black bullhead, brown bullhead, and channel catfish (Table 3.7-5). These fish are all primarily associated with lakes and reservoirs, and probably enter the Portneuf River from the American Falls Reservoir at various times of the year. There are no known population estimates for these species.

Coho salmon have been raised at the fish hatcheries on the Portneuf River and could be present as escapees from the hatcheries. Coho probably do not reproduce in the river, however, and would be limited to the life span of the escapees (Mende, 1992). None were found in the 1988 and 1989 studies of the fish populations in the Portneuf River by Broderick et al. (1989).

Other Important Aquatic Species

Other important aquatic species, discussed below, include suckers, mottled sculpin, and various macroinvertebrates.

Suckers. Both the Utah sucker (*Catostomus ardens)* and largescale sucker (*Catostomus macrocheilus)* are found in the Portneuf River. Suckers are probably the most common fish in the Portneuf River, both in terms of numbers and biomass (Figure 3.7-7). The median size of these fish is about 10 inches (25 cm) with weights ranging from 2.0 to 3.1 pounds (0.9 to 1.4 kg). These fish are relatively fast-growing and live about 10 to 12 years. They are currently not considered a game fish. It is used today for human consumption, although to a far lesser extent than in the past. However, approximately 329,000 pounds (149,400 kg) of sucker were taken commercially in the last half of 1992 from the American Falls Reservoir for human consumption (Table 3.7-6). In addition to humans, suckers are also eaten by most piscivorous predators such as larger fish, mergansers, ospreys, and eagles (Sigler and Sigler, 1987).

Suckers feed on both plants and animals. As fry, suckers eat small zooplankton and as they grow larger and become bottom dwellers, they change their diets to aquatic insect larvae, diatoms, and other plant material. Large suckers feed on such bottom organisms as crustaceans, aquatic insect larvae, earthworms, and snails (Sigler and Sigler, 1987). The largescale sucker is listed as tolerant to environmental stress by the EPA (1989f).

Mottled Sculpin. The mottled sculpin (*Cottus bairdi*) is important because it is probably the second most common fish in the Portneuf River (Figure 3.7-6) and provides a significant amount of food for trout and other game fish. This fish attains an age of 5 years and occasionally a total length of 6.0 inches (15.2 cm). Lengths of 3.0 to 4.0 inches (7.6 to 10.2 cm) are more common, however. The mottled sculpin eats almost entirely aquatic insects, with plant material and fish a minor part of the diet (Sigler and Sigler, 1987).

The preferred habitat of the mottled sculpin is clear, cool mountain streams of rapid to moderate current. The bottom typically consists of coarse gravel, small loose rocks, or rubble. Preferred summer temperatures vary from 55.4°F to 64.4°F (12.8°C to 18°C) and water depths are commonly 1.9 ft (0.6 m) or less. These fish associate with vegetation and live under stones or in moderately swift riffles (Sigler and Sigler, 1987). The Portneuf River seems to provide good habitat for the mottled sculpin. The mottled sculpin is listed as intermediate in tolerance for environmental stresses (EPA, 1989f).

Macroinvertebrates. By convention, freshwater macroinvertebrates are those animals without backbones that are large enough to be seen without magnification. The main taxonomic groups of macroinvertebrates occupying freshwater environments are annelids, crustaceans, flatworms, mollusks, and insects (usually predominant) (Platts et al., 1983).

Macroinvertebrates are important intermediaries in the utilization of plant material, such as algae, vascular hydrophytes, leaves, and wood, and the recycling of nutrients in aquatic environments. They are a major food source for fish and serve to determine the well-being of those populations. The macroinvertebrates possess several characteristics that make them useful for detecting environmental perturbations: in particular, (1) most members of this community possess limited mobility so that their status reflects conditions in the immediate vicinity of the collection site, and (2) most of the organisms (mussels are the main exception) have life spans of several months to a few years. Thus, their characteristics are a function of conditions during the relatively recent past, including sporadic influences that would be difficult to detect by periodic microbial or chemical analysis (Platts et al., 1983).

Many of the important vertebrate species discussed in previous sections depend directly or indirectly on the macroinvertebrate organisms living in the benthos (river bottom) of the Portneuf River. Macroinvertebrates are eaten by a large variety of fish, birds, amphibians, and other organisms, which are themselves eaten by the top-level consumers such as eagles, cormorants, and herons.

The most recent study of the macroinvertebrate community in the Portneuf River was conducted by the City of Pocatello (1989) to determine the effects of its STP. Results from taxonomic analysis of the benthic samples suggest that there is environmental stress associated with the effluent discharged from the STP. Species richness is the number of different types or taxa of macroinvertebrates found at a site. During August 1989, the average species richness decreased from 12 taxa above the effluent pipe (but below the EMF facilities) to eight taxa at two stations located within the STP effluent plume. The organisms that tended to avoid Pocatello's STP effluent were those groups that are associated with clean flowing water and are especially sensitive to environmental stress (Ephemeroptera [mayflies], Plecoptera [stoneflies], and Tricoptera [caddisflies]).

Figure 3.7-8 shows the abundance of selected macroinvertebrate taxa at the five sample locations in relation to the approximate location of the STP effluent plume. Benthic scientists have ranked macroinvertebrate groups based on their tolerance of environmental stress. The scale of tolerance values (TV) ranges from 1 to 10, with 1 being the most susceptible to stress, and 10 the most tolerant. The Chironomidae and Oligochaeta are wormlike animals with aquatic forms that can survive in polluted environments; these groups have TVs in the 6 to 10 range. Groups with low tolerance to environmental stress–the Baetidae, the Tricorythidae (mayflies) and the Brachycentridae and Hydropsychidae (caddisflies)–were clearly less abundant in the effluent plume during summer 1989. Thus, in this 1989 study, the invertebrate groups with the lowest tolerance to environmental stress were most abundant in the area upstream from the STP discharge. The Oligochaeta, on the other hand, were relatively more abundant in the STP effluent than upstream from the effluent (City of Pocatello, 1989).

The general conclusion of the macroinvertebrate portion of the study was that there was a predominance of toxic-tolerant organisms, and a reduction in species richness downstream from the STP effluent. Since the macroinvertebrate sample location that was farthest downstream (Station 5) had the highest species richness and greatest abundance of mayflies, the study concluded that the west (spring water) side of the Portneuf River had comparatively good environmental health. This conclusion is consistent with the water chemistry results, which indicated the presence of a channel of high-quality water around the effluent mixing zone (City of Pocatello, 1989). The City of Pocatello concluded that this west side of the Portneuf River, which contains the outfall from the FMC facility, supported comparatively good aquatic habitat in comparison to reaches above the EMF facilities.

Fish Farms

Two fish rearing facilities are located on the Portneuf River in the EMF study area, at about river miles 12.4 (Batiste Spring fish farm at the Rowland creamery) and 11.4 (Papoose Spring) (Figure 3.7-2). Both of these properties are operated by Aqua Sea Inc. At the fish farm, coho salmon and rainbow trout are raised and sold for stocking other streams and processed elsewhere. Annual production rate for the rainbow trout is higher, since rearing coho salmon is still in the experimental stage. The fish facility at the Rowland creamery uses water from Batiste Spring and other groundwater discharged to the spring channel, and the downriver facility uses water from Papoose Spring. The fish at these facilities are fed commercially prepared fish food and sold as either fingerlings (for stocking) or at about 1 to 1.5 years of age, for processing at the food plant. Production at the two fish facilities is estimated at about 49,896 pounds (22,680 kg) per year of stockers and 9,979 pounds (45,360 kg) per year of harvest for human consumption (Marquardt, 1992).

Kokanee salmon have been reported by the Shoshone-Bannock Tribe (1992) to be present in this stretch of the Portneuf River. However, Mr. Marquardt, plant manager of Aqua Sea Inc., could not recall ever raising Kokanee salmon at either of the fish farms.

Surface and Subsurface Characterizations
Tables for Section 3.7

TABLE 3.7-1
SUMMARY OF AREAL EXTENT OF VEGETATION/HABITAT TYPES
WITHIN THE EMF STUDY AREA

VEGETATION/HABITAT TYPE[a]	AREAL EXTENT		PERCENTAGE OF EMF Study Area
	Acres	Hectares	
Agriculture, includes 2,848 acres (1,153 ha) of fallow/disturbed areas	7,203	2,916	40
Sagebrush steppe, includes 481 acres (195 ha) of cliff habitat	6,620	2,680	37
Wetland/riparian	597	242	3
Residential, industrial, commercial	3,663	1,485	20
Total	18,083	7,323	100

Notes: (a) See Figure 3.7-2 for map of vegetation/habitat distributions within the EMF study area.

Table is based upon vegetation/habitat distributions shown in Figure 3.7-2 for areas within a three-mile radius of the EMF facilities.

TABLE 3.7-2
SUMMARY OF U.S. FWS WINTER WATERFOWL SURVEYS

Year	Number of Waterfowl
1981	151,149
1982	37,839
1983	9,571
1985	16,772
1986	5,135
1987	33,922
1988	21,391
1989	21,788
1990	70,770
1991	42,840

Source: Idaho Department of Fish and Game (1981-1991).

TABLE 3.7-3
DUCK AND GOOSE HARVEST DATA

Year	Number of Ducks	Number of Geese
1981	8,300	3,072
1982	8,363	2,289
1983	7,591	1,509
1984	7,396	1,818
1985	3,425	2,328
1986	3,738	1,602
1987	1,499	799
1988	2,388	3,833
1989	3,482	5,185
1990	1,698	4,728

Source: Shoshone-Bannock Tribe (1992).

TABLE 3.7-4
WIDTH, DEPTH, AND FLOW CHARACTERISTICS MEASURED AT SELECTED LOCATIONS ON THE PORTNEUF RIVER (ON OCTOBER 27, 1992)

Location[a]	River Mile	Width (meter)	Depth (meter)	Current (m/sec)	Flow (m^3/sec)
Main Street Bridge (SW25)	20.7	12.2	0.9	0.4	2.5
Batiste Lane (SW16) Bridge	13.3	11.9	0.7	0.5	2.3
River at Batiste Spring discharge (SW10)	12.0	26.2	1.1	0.7	5.4
Siphon Road Bridge (SW03)	11.0	25.0	2.4	0.5	9.5
Station 1 (SW01)	10.0	25.0	0.9	0.7	9.1

Note: [a] See Figure 1.3-4 for surface water sampling locations.
See Appendix K for additional flow gaging information.

TABLE 3.7-5
GAME AND NONGAME FISH SPECIES FOUND IN THE PORTNEUF RIVER

Common Name	Scientific Name	Reference
GAME FISH		
Fish farm rainbow trout[a]	*Oncorhynchus mykiss*	Broderick et al., 1989
Wild rainbow trout	*Oncorhynchus mykiss*	Broderick et al., 1989; Shoshone-Bannock Tribe, 1992
Brown trout	*Salmo trutta*	Broderick et al., 1989; Shoshone-Bannock Tribe, 1992
Kokanee salmon[a]	*Oncorhyncus nerka*	Shoshone-Bannock Tribe, 1992
Coho salmon[a]	*Oncorhyncus kisutch*	Marquardt, 1992
Hybrid trout (Rainbow x Cutthroat)	*O. mykiss x O clarkii*	Broderick et al., 1989
Mountain whitefish	*Prosopium williamsoni*	Broderick et al., 1989; Johnson et al., 1977; Mohr, 1968; Shoshone-Bannock Tribe, 1992
Yellow perch	*Perca flavescens*	Johnson et al., 1977
Black crappie	*Pomoxis nigromaculatus*	Johnson et al., 1977
Black bullhead	*Ictalurus melas*	Johnson et al., 1977
Brown bullhead	*Ictalurus nebulosus*	Shoshone-Bannock Tribe, 1992
Channel catfish	*Ictalurus punctatus*	Shoshone-Bannock Tribe, 1992
NONGAME FISH		
Common carp	*Cyprinus carpio*	Broderick et al., 1989; Shoshone-Bannock Tribe, 1992
Large scale sucker	*Catostomus macrocheilus*	Broderick et al., 1989
Utah sucker	*Catostomus ardens*	Johnson et al., 1977; Shoshone-Bannock Tribe, 1992
Redside shiner	*Richardsonius balteatus*	Broderick et al., 1989; Mohr, 1968; Johnson et al., 1977; Shoshone-Bannock Tribe, 1992
Longnose dace	*Rhinichthys cataractae*	Broderick et al., 1989; Mohr, 1968
Speckled dace	*Rhinichthys osculus*	Broderick et al., 1989; Mohr, 1968
Mottled sculpin	*Cottus bairdi*	Broderick et al., 1989; Shoshone-Bannock Tribe, 1992
Utah chub	*Gila atraria*	Johnson et al., 1977; Shoshone-Bannock Tribe, 1992

Note: [a] Fish farm escapees that are occasionally found in the Portneuf River.

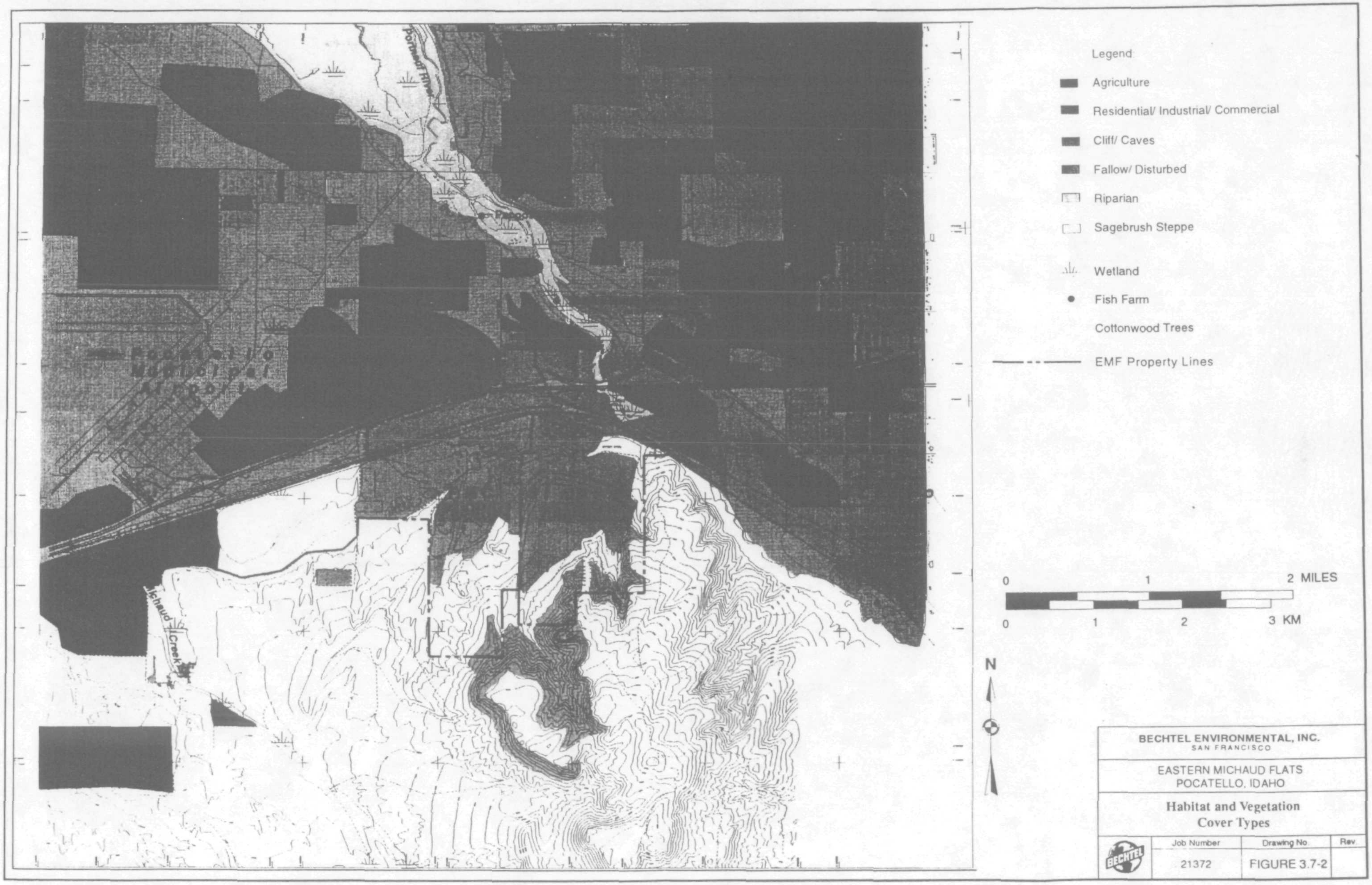
TABLE 3.7-6

AMERICAN FALLS RESERVOIR COMMERCIAL FISHING CATCH

FISH SPECIES		CATCH[a]	
Common Name	**Scientific Name**	**pounds**	**(kilograms)**
Suckers	*Catostomus ardens* and *C. macrocheilus*	329,000	(149,400)
Common carp	*Cyprinus carpio*	163,400	(74,200)
Utah chub	*Gila atraria*	9,600	(4,400)
	Total Catch	502,000	(228,000)

Note: [a] Approximate commercial fishery catch for the American Falls Reservoir from July to November 1992 (Thompson, 1993).

Surface and Subsurface Characterizations
Figures for Section 3.7



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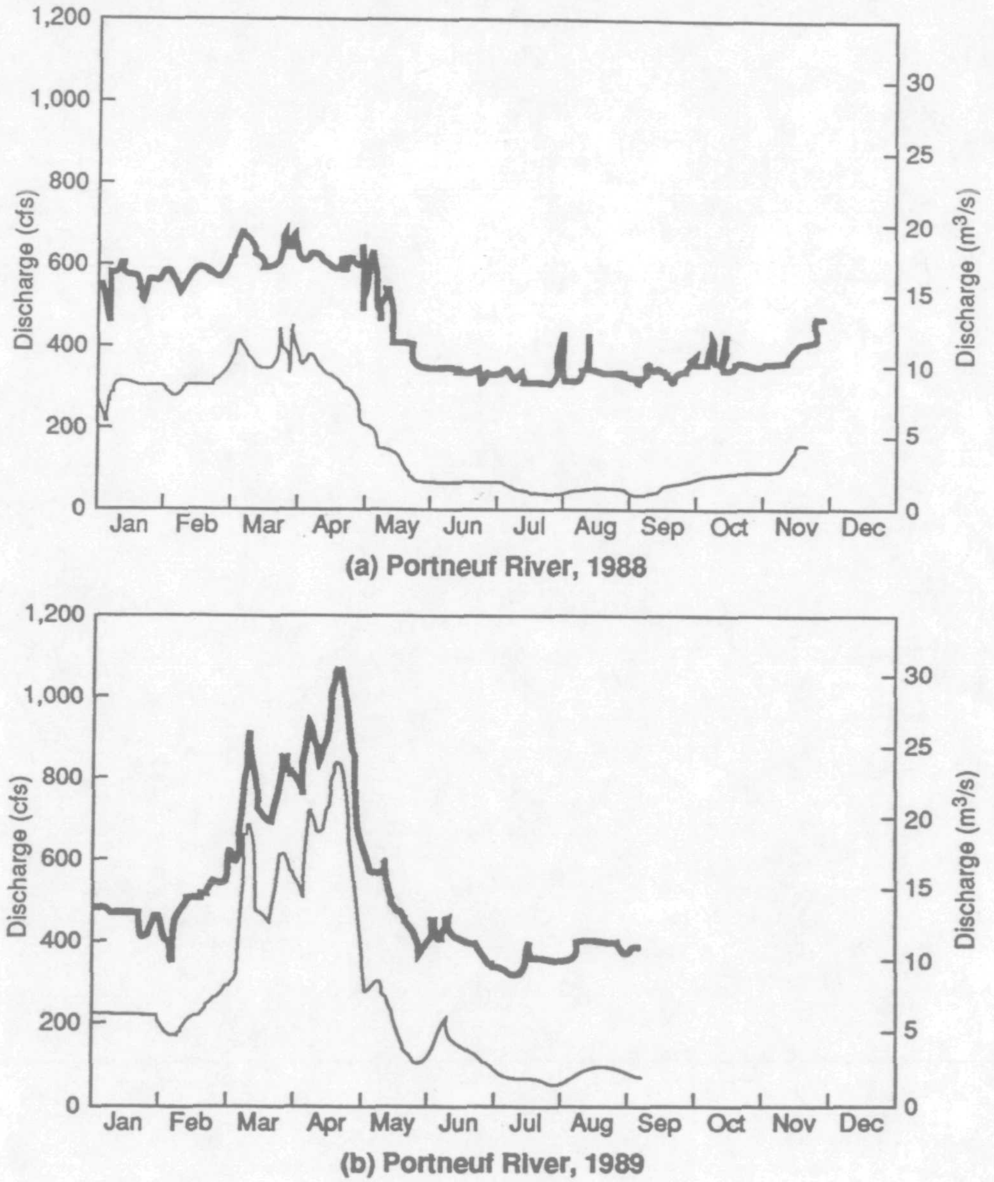
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Habitat and Vegetation Cover Types

Job Number	Drawing No.	Rev.
21372	FIGURE 3.7-2	



Legend:

Tyhee plus Michaud Canal

Carson Street

Note:
Discharge of the Portneuf River at the Carson Street (River Mile 18) and Tyhee (River Mile 11) USGS gauging stations. A pumping station diverts water into the Michaud Canal at a point upstream from the Tyhee gauge. The Tyhee plus Michaud Canal plot is the estimated discharge immediately upstream from the Portneuf pumping station (Siphon Road), assuming no water is lost or gained from the channel between the pumping station and the gauge at Tyhee (City of Pocatello, 1989).

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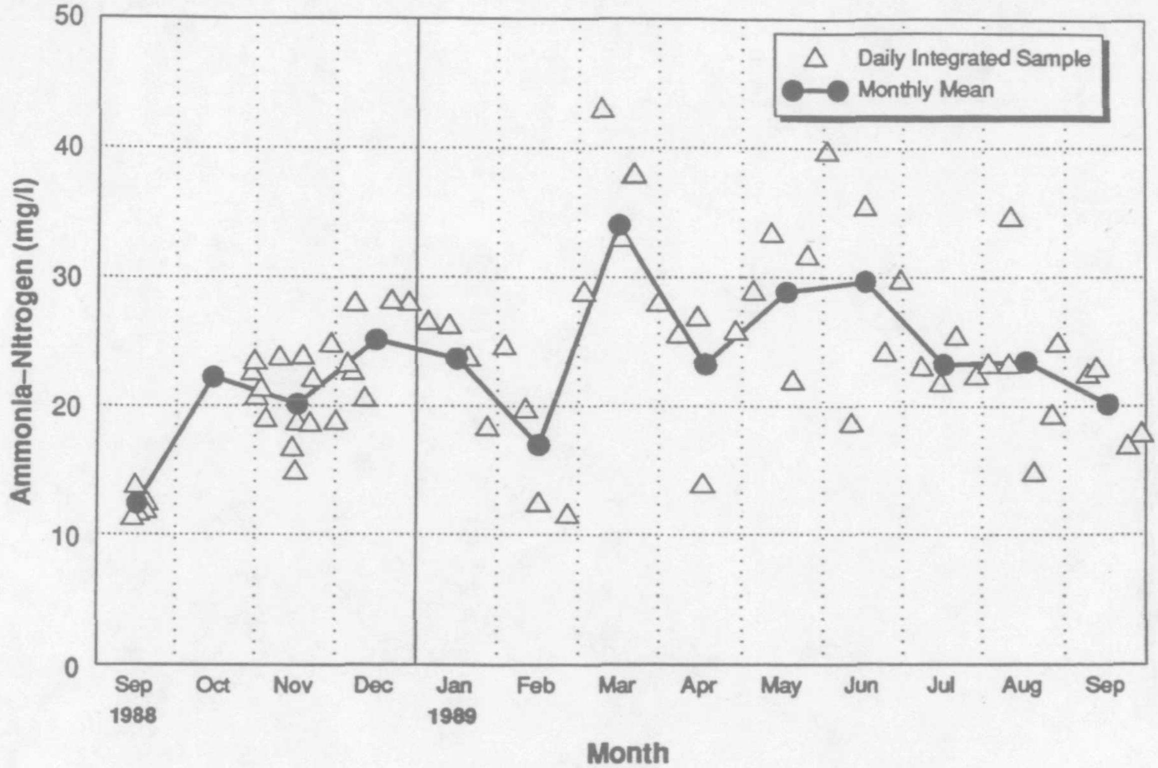
Discharges at USGS Gauging Stations on Portneuf River, 1988 and 1989

JOB No.	DRAWING NO.	REV.
21372	FIGURE 3.7-3	



Source: City of Pocatello, 1989.

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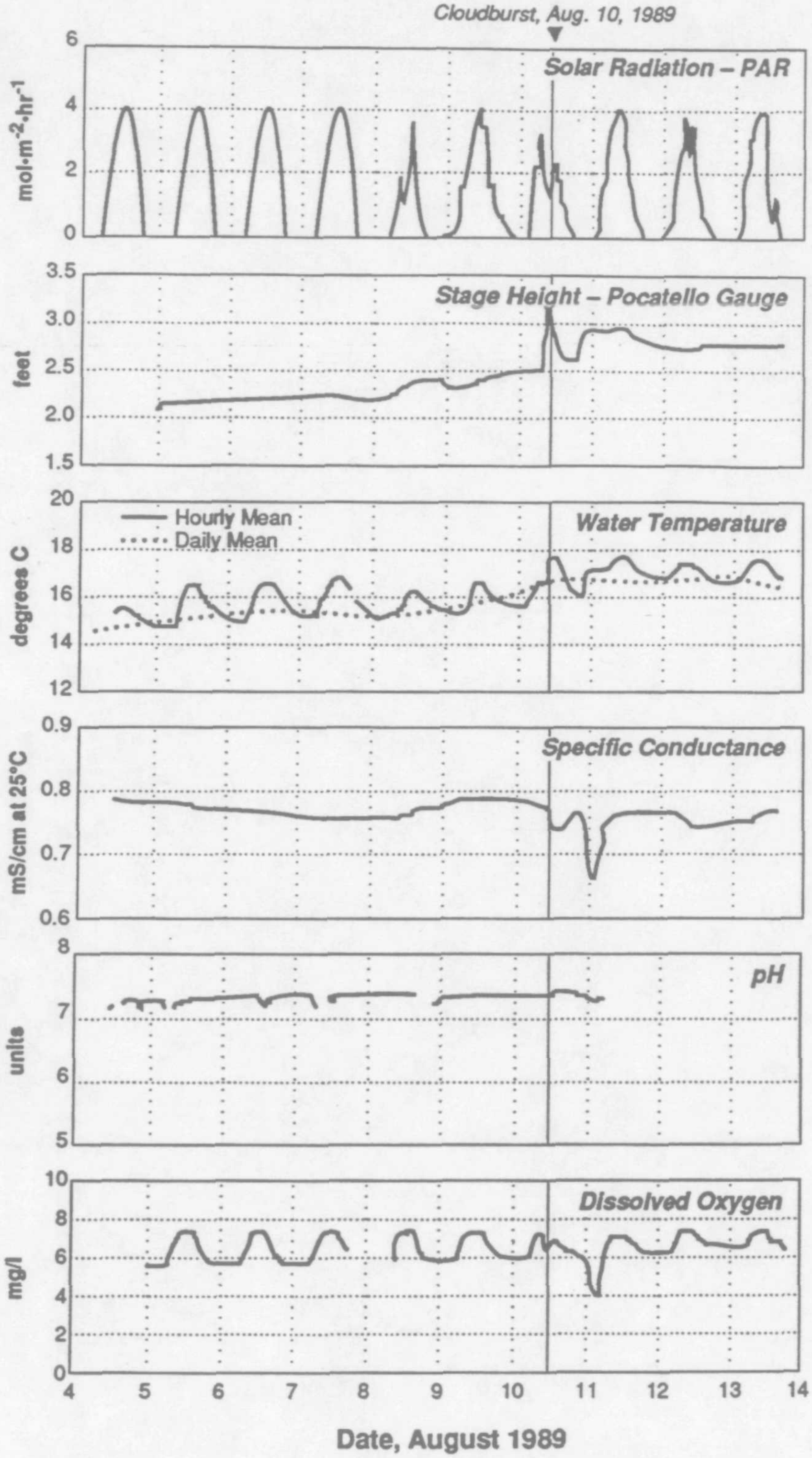
Ammonia-Nitrogen Concentrations in Pocatello STP Effluent, September 1988 – September 1989

JOB No.	DRAWING NO.	REV.
21372	FIGURE 3.7-4	



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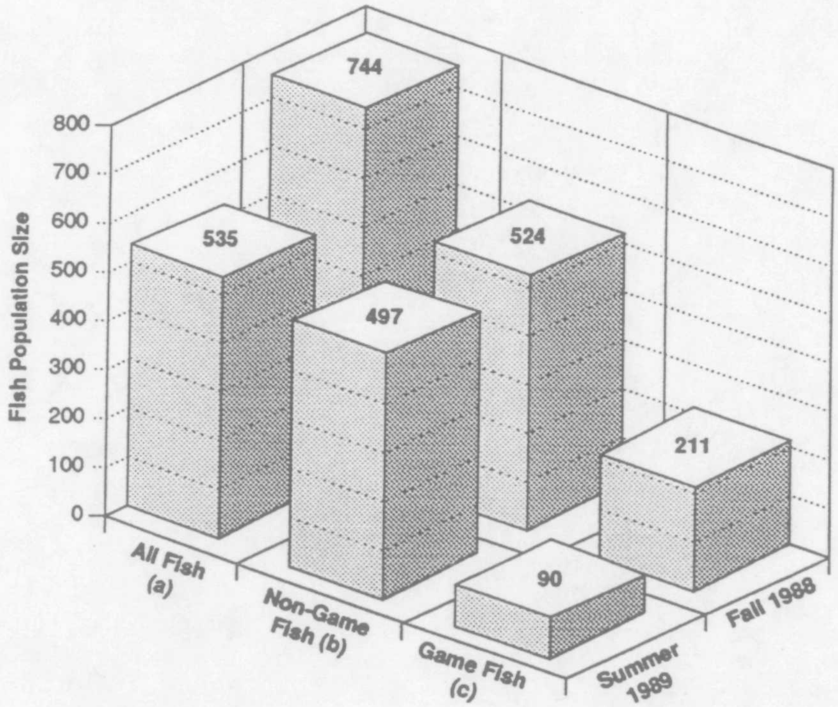
Water Quality Monitoring Results at Rowland Creamery on Portneuf River

JOB No.	DRAWING NO.	REV.
21372	FIGURE 3.7-5	

Note:

Results of continuous monitoring of water quality at the Rowland Creamery (about 100 m upriver from the STP outfall) on the Portneuf River during the period preceding and following the August 10, 1989, rainstorm (City of Pocatello, 1989).



Notes:

Source: City of Pocatello, 1989.

(a) Data for "All Fish" is independent of other categories; totals do not equal.

(b) Non-game fish: whitefish, carp, sculpin, shiner, dace.

(c) Game fish: brown trout, rainbow trout, rainbow-cutthroat trout hybrids.

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EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Estimated Game and Non-Game Fish Populations—Portneuf River, 1988 and 1989		
JOB No.	DRAWING NO.	REV.
21372	FIGURE 3.7-6	

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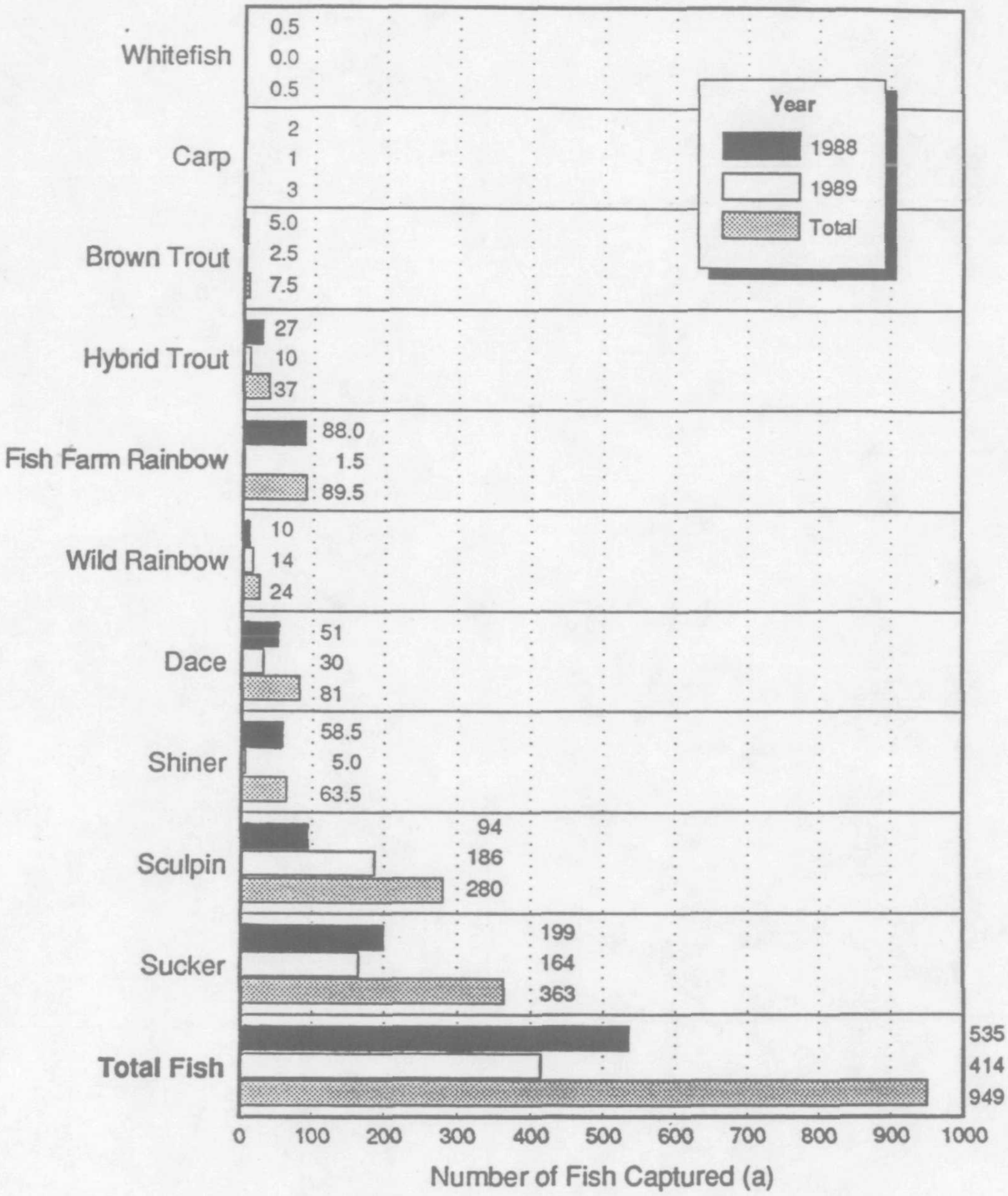

Notes:

(a) Numbers represent catch per unit effort.
Normalized for one hour.

Data from Broderick et al, 1989.

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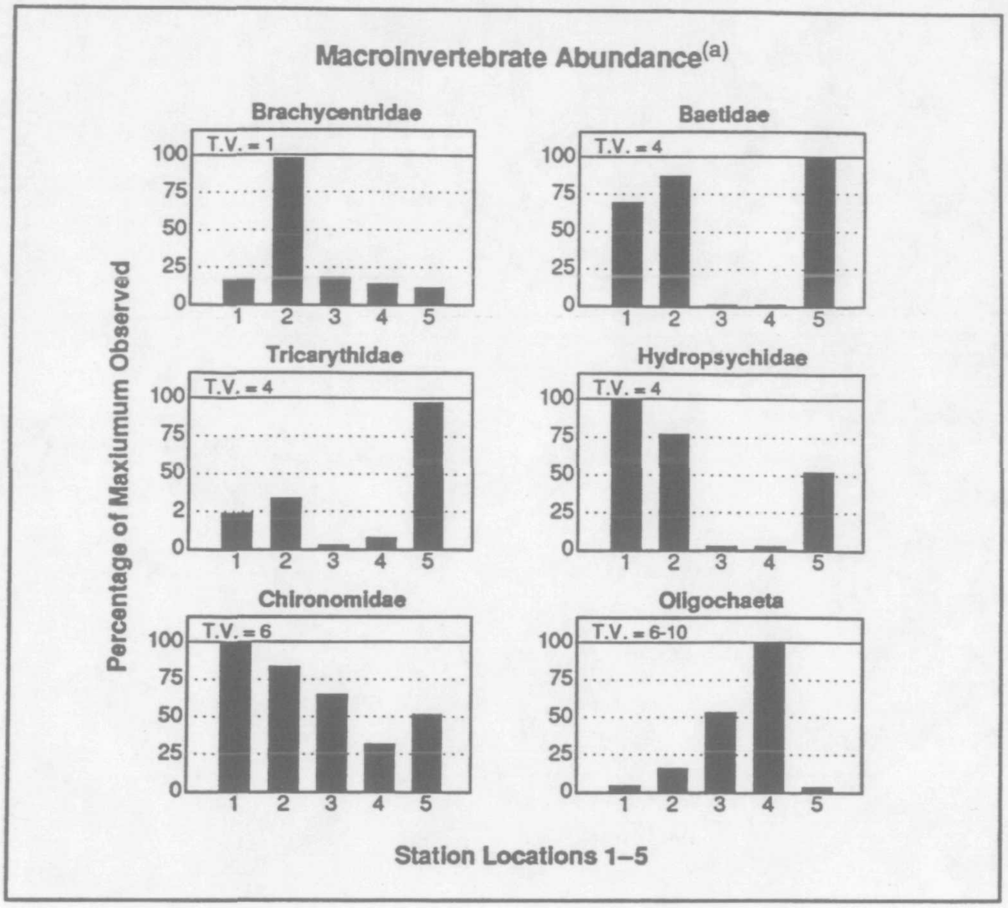
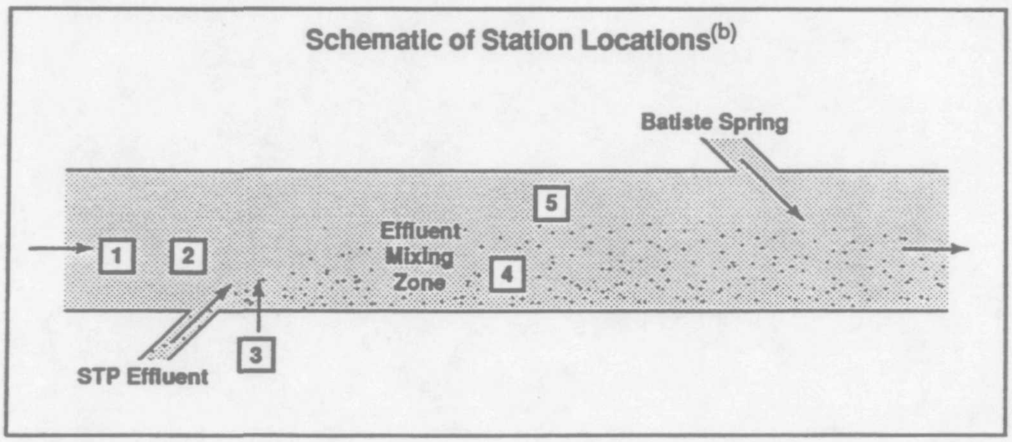
Total Number of Fish Captured in the Portneuf River—1988 and 1989

JOB No.	DRAWING NO.	REV.
21372	FIGURE 3.7-7	





Legend

1 Station Location

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Macroinvertebrate Abundance for Selected Taxa in the Portneuf River—Summer 1989

JOB No.	DRAWING NO.	REV.
21372	FIGURE 3.7-8	

Notes:

(a) Abundance is expressed as the percentage of maximum observed in basket samplers with the greatest abundance equal to 100%. T.V. = Tolerance Value.

(b) Station locations in relation to the effluent mixing zone from the city's sewage treatment plant (STP) near River Mile 12.7. (City of Pocatello, 1989).